THE AMERICAN
JOURNAL OF PSYCHOLOGY
Founded in 1887 by G. STANLEY HALL

Vol. XLIX JULY, 1937 No. 3

# THE MEMORIAL FORMS OF APPREHENSION

By MARGARET BALLOU ERB, Letchworth Village

Throughout the life-course of man an important place is accorded at every stage to memory. As soon as the infant is held to be responsible for his behavior, parent and attendant charge him 'to remember;' to remember the painful and unsocial issues of past misdeeds, to remember admonitions and threats, to remember manners, civilities, and the learned skill of tools and toys. Upon the school child the chief memorial task falls in a different way. His task is 'to memorize.' Lessons must be 'learned' that they may provide him with materials for free recital and use. The past has prepared him to 'reproduce' the fruits of his study. He rattles off the multiplication table without a backward glance at the studying time, as if he had his arithmetic actually open before his eyes. Youth—to advance to a third gross stage of life—is supposed to be a time of preparation for the adult years. The adolescent is admonished to lay up 'in memory' facts and skills, principles and rules, knowledge and wisdom, that he may utilize them when he is mature. Maturity itself is said to succeed only when it somehow holds what it acquires and turns it to account in business, the professions, and the arts of practice. Age seems to be the only life-phase which does not need the admonition to learn, to remember, and to recall; because age, dropping the duties of active life, may have the time and the inclination to return to a personal past for its entertainment and for its garrulous recital of things done and accomplished.

The human operations indicated by the words 'memory,' 'memorize,' 'learn,' 'commit,' 'learn by heart,' 'store up for the future,' and 'live in the past,' are so deeply stamped upon the traditions of a people that it is small wonder that psychology, too, should reserve a large place for their discussion

* Accepted for publication May 20, 1936. The study was carried out in the Psychological Laboratories of Cornell University under the direction of Professor Bentley.



BOSTON UNIVERSITY
COLLEGE OF LIBERAL ARTS
LIBRARY

and should have filled many pages of its books and researches with the exposition and cultivation of them.

But when we come to the careful study of these important subjects, it behooves us to be more exact and critical of our memorial terms and concepts than the grosser uses of living demand. The critical psychologist, observing his own field, is doomed to disappointment, however, when he sets his hopes too high, expecting clarity, concise definition, and a consistent treatment of 'memory.' He will find, indeed, that the terms named have often been used by psychologists almost as loosely as in common speech. It will be necessary, therefore, in approaching the subject for research upon a quite specific problem in memory, to block out, in a preliminary way, the main subdivisions of the general subject.

## The Three Traditional Ways of Regarding 'Memory'

Most psychological studies in the field of memory may be brought under one of three general topics: (1) the memory image, (2) changes through time of learned or memorized materials, and (3) functional means by which the organism refers backward to its biographical past. All 'memorial' studies hold in common an implication of the past. In the first group, the past is regarded as the *origin and source* of the memory image. A perception, 'impression,' or 'sense impression' is alleged to have left behind it a memorial duplicate or image of itself. In the second group of studies, any sort of experience is said to *dispose the organism toward a similar experience.* When the disposition is so strong that the experience can be repeated *without its original conditions* (the poem as read from the page, the series of nonsense syllables as listened to, the drawing as exposed to the learner), the original material is regarded as 'memorized,' 'committed,' or 'learned.' It can then be 'reproduced,' *i.e.* recited, rehearsed, written down, or delineated. Here the past is involved repetitively in what is picturesquely called 'the learning process.' In the last of our three classes of study, *a biographical fragment of the past is the issue or product of a memorial or remembering function of the organism.* In brief, we may say that in (1) the past supplies the original of a present copy, the memory image; in (2) the past supplies the conditions for memorizing; and in (3) the past is the outcome of a remembering function or operation.

In spite of the fact that, in most textbooks and in many of the more serious accounts of matters psychological, these three subjects are either treated together and without distinction under the terms memory and learning or else one of the subjects (most frequently 'memorizing') is expounded at the neglect of the other two, we must emphasize the contention

that they are fundamentally different. They differ as problems, their psychological contexts differ, they are studied by unlike methods, and their factual outcomes are quite unlike. We go on to name and distinguish representative researches already done in the three 'memorial' subjects.

*(1) The memory image.* This subject springs naturally from the ancient distinction of faculties or powers of the mind. Here memory was primary. It represented a power unique and peculiar; the power to reinstate the past. When faculties were rejected in favor of the doctrine of elemental processes, a novel element, to be coördinate with sensation and to stand to memory, imagination, and thought as sensation stands to 'sense perception,' was called for. Here also is an echo of the English distinction between 'impression' and 'idea' and between 'sense' and 'intellect.'

The first clean and consistent use of this 'memorial element,' the 'simple memory image,' is to be found in Külpe (1893). Directly out of it came laboratory studies by Bentley, Whipple, Kuhlmann, and others.[1] The first aim of these studies was to obtain and describe the memorial counterpart of visual (colors, grays), auditory (tones and noises), and other sensational qualities. In Bentley and Whipple, *Os* were asked to obtain an imaginal color, gray or tone, and to compare it with a like quality which had been obtained at a variable time before by a perceptive presentation from a light or sound source. The first problem was that of 'fidelity' of the imaginal with the sensational quality. Soon the quest became more general, the experimenter seeking a comparison between a total perception and its corresponding memory. But the term 'memory image' was retained. Kuhlman, for example, researched upon the place of imagery in the reproduction of geometrical figures. Reproductions were made immediately after the presentation of the stimulus-object and at intervals up to ninety days. Perky compared memorial and imaginational 'images' as to stability, temporal course, visual characteristics and affective elements.[2] A more recent investigator, Allport, set out to study the memory-image of two geometrical figures over a period of time. In the 'reproduction,' the subjects were instructed to call up images and to draw from them. Allport did not require reports, however, and presents no evidence to show that imagery, memorial or other, was used by the *Ss* in making their drawings.[3]

A fairly long list of researches upon the memory image has been recently reviewed by Brown.[4] It is to be carefully noted, however, that neither Brown nor many of the experimenters whom Brown cites as investigating 'images' made an adequate attempt to assure the presence of anything which might properly be called a memorial image or any other form of image. The methods only discovered the likeness or difference of *objects as perceived* and *as 'reproduced,'* by whatever

[1] M. Bentley, The memory image and its qualitative fidelity, this JOURNAL, 11, 1899, 1-48; G. M. Whipple, An analytic study of the memory image and the process of judgment in the discrimination of clangs and tones, *ibid.*, 12, 1901, 409-457 and 13, 1902, 219-268; F. Kuhlmann, On the analysis of the memory consciousness: A study in the mental imagery and memory of meaningless visual forms, *Psychol. Rev.*, 13, 1906, 316-348.

[2] C. W. Perky, An experimental study of imagination, this JOURNAL, 21, 1910, 436 ff.

[3] G. W. Allport, Change and decay in the visual memory image, *Brit. J. Psychol.*, 21, 1930, 133-148.

[4] W. Brown, Growth of 'memory images,' this JOURNAL, 47, 1935, 90-102.

means, in the absence of the impressed object. The comparison is made, therefore, between two sorts of product of organic function, *i.e.* between objects (taken in the ordinary sense). The studies give very little evidence either of anything 'imaginal,' in the sense of a 'mental content,' or of anything 'memorial' in the sense of a specific function or operation. The name 'memory image' might therefore well be dropped in this context.

This group of experiments is large. Early came Philippe's investigation.[5] He presented tactually five common objects and asked *O* to draw the object after varying periods of time. Wulf's work, done primarily as a counterblast to G. E. Müller's blurring and convergence upon a type after passage of time, brings out two kinds of change (*Präzisierung* and *Nivellierung*) which were observed in geometrical figures drawn at intervals after the original presentation.[6] Following these two experiments and extending the problem through a wide variation of stimulus-objects, by methods of presentation and of drawing the figures, came the studies of Piéron,[7] Perkins,[8] Gibson,[9] Carmichael, Hogan and Walter,[10] with Brown's[11] investigation summarizing the group. Allport generally confirmed the results of Wulf and Gibson, using children as subjects.[12]

These studies are primarily concerned with classification of the types of change found in drawings under given conditions. Each investigator, while referring to the earlier studies, has supplied his own list of 'errors' or 'directions of change.' The terms used by previous investigators have been freely discarded because of the difficulty of translating and applying the various criteria of change in the several experiments. No comparison of the categories has been made which shows their similarities and differences as employed by individual investigators. The result is that the lists of errors are as diverse as the number of men working upon the problem, and no useable summary is at hand. The number of directions of change ranges from two (Wulf) to forty-two (Allport). The difficulty may in part be attributed to the fact that, in determining the character of the change which has occurred during a series, the opinion of the experimenter must be taken as final. It is likely that the drawings of various experiments could be interpreted in other ways were another individual or other individuals to classify the changes observed.

There is evidence, however, that changes do occur in successive drawings and that these changes depend upon specified conditions, *e.g.* meaning attributed to the figure, verbal description, presence or absence of an image, and the way in which the object was originally apprehended.

By obtaining from *O* at various time-intervals successive drawings of an object, the experimenter divines progressive directions of deviation from the stimulus-object. For *O* the task is to draw as accurately as possible, using resources available

---

[5] J. Philippe, *L'image mentale: évolution et dissolution*, 1903.

[6] F. Wulf, Über die Veränderung von Vorstellungen (Gedächtnis und Gestalt), Beiträge zur Psychologie der Gestalt, *Psychol. Forsch.*, 1, 1922, 333-373.

[7] H. Piéron, Recherches comparatives sur la mémoire des formes et celles des chiffres, *Année Psychol.*, 21, 1914-1919, 119-148.

[8] F. T. Perkins, Symmetry in visual recall, this JOURNAL, 44, 1932, 473-490.

[9] J. J. Gibson, The reproduction of visually perceived forms, *J. Exper. Psychol.*, 12, 1929, 1-39.

[10] L. Carmichael, H. P. Hogan, and A. A. Walter, An experimental study of the effect of language on the reproduction of visually perceived form, *ibid.*, 15, 1932, 73-86.

[11] W. Brown, *op. cit.*

[12] G. W. Allport, *op. cit.*

at the moment, *i.e.* perceiving, imagining, remembering, inspecting, or a combination of these modes of performance. There may or may not be reference to the original activity at the time of the drawing. There is no way of knowing definitely whether or not such reference is present, for it is not guaranteed by the observation. *O* is requested to draw something which he saw previously and, whatever the product, it is assumed to be memorial. The investigators have been concerned, not with the performance, but with *the product* which is turned out, a product which is loosely called 'memory.'

*(2) Memorizing and reproducing.* In this group of studies the problem is that of the conditions upon which accurate recital of some group of materials depends. Here the emphasis is upon the accuracy of the product, as calculated in terms of 'errors.' In so far as the present product varies from the originally presented material, it is called 'wrong.' If the individual succeeds—in the absence of the original—in turning out a faithful copy of the original, the material is said to be 'memorized' or 'learned.' This product, of whatever sort, is considered the important thing. The psychological activity used in turning out the product is ignored. It is not in strictness a 'reproduction' of anything. When, as a result of repetition and renewal of performance. *O* is able to turn out a duplicate of the original without error, he is said to have 'learned.' It is not a reproducing of some past product. The product is the present result of historical antecedents which guide the present performance and determine the product, but there is, as a rule, no backward reference by the 'learning' organism to those antecedents. While previous performance is implied in the present ability to list ten or twelve nonsense syllables in correct order, there is, so far as *O* is concerned, no active reference in the performance, at the moment of recital, to earlier activity.

'Reproduction' has been used in the designation of one sort of 'memory' or 'learning' method and only in this historical connection does it have an exact meaning, *i.e.* that particular method. What is commonly called reproduction is more accurately described by a characterization of the particular product under consideration and by a description of the conditions under which it appears.

By far the largest group of experiments which have been called memorial is concerned rather with this sort of study of the effects of repetition of performance upon product. Memory and learning have been used interchangeably as titles for this type of investigation. Ebbinghaus, the accredited inventor in this field, announced in his preface to *Das Gedächtnis* that "the term, memory, is to be taken here in its broadest sense, including learning, retention, association and reproduction."[13] And the use of memory and learning as synonyms has continued since that time.[14]

With the vast amount of material which has to do with 'memorizing' of nonsense syllables, with 'learning' of mazes or skilled acts, and with problem-solving, we shall be little concerned. No attempt will be made at this point, therefore, to do more than refer in passing to this large body of experimental evidence upon the change in *result of performance* through repetition.[15]

---

[13] H. Ebbinghaus, *Ueber das Gedächtnis*, 1885.

[14] J. A. McGeoch, The vertical dimensions of mind, *Psychol. Rev.*, 43, 1936, 107-129. In this article, where he considers 'learning' as the major vertical dimension of mind, McGeoch occasionally refers to learning and memory as the same thing (see p. 124).

[15] Some idea of the range of subjects considered under this heading may be gained by cursory examination of the variety of topics included in such review-articles as

*(3) The memorial functions.* There is still a wide range of facts not included in the works just cited under *(1)* and *(2)*. These facts relate to the apprehension of objects and events as belonging to the individual biography. Here we find the type of thing which occurs when a person comments 'I remember when . . . ,' or 'Do you remember that time when we . . . ?' and so on. It has largely been taken for granted that the individual has at his command a large fund of reminiscence which may be recalled under appropriate facilitating circumstances. In the experiments upon change in a product over a period of time, there is no conclusive evidence that simply because *O* is instructed to draw something which he has previously seen there will be a biographical or memorial reference to that original activity. The same objection applies when a person is asked 'Do you know the words of that song?' and the stanzas are run off without *memorial* reference to the original occasion or occasions when the song was heard. *The kind of performance* at the moment is disregarded. The concern is for the product, for the words repeated or omitted, and there is no reference to the sort of activity in present course.

We have maintained that apprehension which contains a temporal reference backward to the scenes, objects, and events in the person's own past is the kind of performance which is most properly called 'memorial.'[16] Here the emphasis is upon the kind and direction of the performance rather than upon the product. The earlier investigators have not—as a rule—dealt with performance but with accomplishment. The psychologically important thing, however, is not the end-product of the activity but the activity itself and its conditions.

Except for such experiments as those of Bentley, Whipple, and Kuhlmann, where the presence of a memorial image was ascertained, the investigators in the first group have dealt with products of performance without reference to performance itself. *O* is presented with an object or figure and after an interval he is asked to draw or describe what he saw before. No evidence is adduced that we find under these conditions more than the influence of the past upon the present drawing. The past determines, in part, the present product but does not enter actively into that product. There may or may not be a present reference to the past. But we need more than this for remembering. The biography of an individual operates actively and determines not only remembering but any performance active at the moment. What the individual has done, seen, heard, known, etc.—all products of previous performance—is continually at work setting the direction of any activity at a given moment. The use made by the organism of its past, however, does not generally imply a *reference to* that biography. Apprehending which carries an inherent reference to the history of the individual, which goes toward the past, is memorial. It implies no 'mental' or 'memorial' image as these studies have assumed. It is simply an apprehension of objects and events as belonging to the past.

The second criticism of this group lies in the fact that, by virtue of the method employed, it is not to be expected that *O* will be directed backward. *O* is instructed to draw 'that thing which he saw before.' The experimenter calls for remembering and whatever is done by *O* is so named. No attempt is made to discover by what means the requested drawing is made. That *O* uses various devices to assist him in retaining

---

J. A. McGeoch, Memory, *Psychol. Bull.*, 25, 1928, 513-549; 27, 1930, 514-563.

[16] Cf. Bentley, *The New Field of Psychology*, 1934, 73.

the perceived object is extensively noted, as well as how these devices and aids influence the course of change of the drawing. There is not only no attempt to determine functional mode, but no discovery is made as to whether the mode varies from time to time. Whatever *O* did is called memory simply because the experimenter asked for memory.

The difficulty with the learning experiments is primarily a matter of confusion of terms and lack of precise definition. A list of words is perceived and recited a number of times. As the recited list approximates more and more a duplication of the original list and errors are eliminated, *O* is said to have 'learned' them. How is this done? Since learning necessitates prior performance and repetition of that performance, and since the organism is somehow able to retain the products and to produce them in an orderly manner upon request, it must be accomplished in some way and the answer is 'memory.' This statement rests upon no precise psychological conception either of learning or of memory but only upon quantity of product. The most recent consideration of the problem of what learning is makes no attempt carefully to define, and rather uses it in a broad sense to indicate "the phenomena of the learning curves, of the distribution-of-practice experiments, of the immediate memory experiments, and of the host of others of similar kind arrived at and defined by well-known operations. Under the concept learning are included the facts of retention, . . . and the facts of transfer."[17] The common procedure is to determine conditions under which the product of performance (whether perceiving, inspecting, imagining or acting) changes and to count the number of 'errors' made. These changes are not dependent upon any one type of psychological performance but may be consequent upon any one or more of them.

With this repetition, as in repeated encounters with the objects of the immediate surroundings, the temporal reference drops out and the subject is able to recite the alphabet or to drive a car without any temporal reference to origination of the performance or of resultant changes. How this is achieved is partly a matter for the physiologist and neurologist. That it is achieved is well known. We should not, however, confuse the phenomena and conditions of learning with remembering, the apprehension of objects and events which bear an implicit temporal reference to the individual's own past.

Starting from this point, then, our problem has been to answer the following questions: (1) What are the conditions which lead to apprehension of objects and events as of the personal past? (2) What place does remembering hold in the range of apprehensive performances? (3) Does remembering play a unique rôle in the psychological activity of the organism? (4) What are the varieties of the memorial mode?

In order to eliminate the methodological difficulties of earlier work, we set about devising occasions which would lead the organism to apprehend in the true memorial manner. A brief examination of everyday occasions

[17] McGeoch, The vertical dimensions of mind, *op. cit.*, 110. Cf. also G. L. Freeman, The rôle of context in associative formation, this JOURNAL, 42, 1930, 173-212, who has undertaken a final analysis of the actual modes of performance in memorizing.

seemed to show that, under almost any circumstances—as by a turn in the conversation, by direct question, by revisiting old haunts or by meeting friends—the backward direction might be taken. We tried thereupon to duplicate as nearly as possible, under experimental conditions, some of the common occasions which lead to remembering, although without a formal instruction more specific than simply to apprehend. In this way we hoped to obtain an indication of the conditions under which the individual remembers in the ordinary intercourse of daily life and also the place of this kind of function, not only in the apprehensive performances but also its rôle upon occasions more remote from perceiving.

In Part I we have used simple occasions (the presentation of words, questions, rhythms, and the like) which left the organism free to recover, as it would, fragmentary bits of its own biography. In Part II we have impressed materials which lent themselves to narrative synthesis and delineation, in order that we might ascertain the exact form and mode of their memorial recovery after a short interval of time.

## The Experiments

### Part I

*Method.* The procedure used was simple. *O* was seated comfortably in a darkened room. Three types of material were used: (1) words (nouns, adjectives, adverbs, verbs) and questions; (2) familiar objects, familiar campus scenes, novel scenes, and Rorschach inkblot figures; (3) musical selections, noises, and rhythms.[18] There were five observers.[19]

In Series 1, 50 words were read in succession to the *O*s with the formal instruction:

I shall read you a word. Report apprehendings as they come, using 'p' to indicate perceiving, 'i' imagining, and 'r' remembering. Continue until I say 'stop.'

The length of time allowed for each word was variable. *E* permitted *O* to proceed until three or four of the above reporting letters had been given. After 'stop' *O* gave a full report of his performance, indicating type of apprehension, details of product, and course of operation.

In Series 2 use was made of questions. *O* was seated as before in a darkened room. Fifty questions were used. Preliminary trials with *B* indicated that the questions, in order to arouse memorial apprehension, must be quite specific, *i.e.*

---

[18] Some of the materials used will be found in the Appendix.

[19] The observers were Mr. W. S. Neff *(N)* and Mr. T. A. Ryan *(R)*, assistants in the Department, and Mrs. Mary S. Ryan *(S)*, Miss M. L. Lemmon *(L)*, and Mr. H. F. Dahms *(D)*, doctoral students in Psychology. Dr. Bentley *(B)* observed in the preliminary stages of every series.

they should refer to events of somewhat limited scope. *E* read the question distinctly: 2 sec. after its completion *O* was signaled to report as before upon course and type of performance. The instructions were:

I shall ask you a question. Report all instances of apprehending which appear before the signal 'stop.'

In Series 3 *O* was seated before a table in a dark room. On the table in front of him were placed in succession 30 familiar objects of different sorts, some owned by the *O*s, some common objects which had been perceived daily by all *O*s around the laboratory, and some objects symbolic of particular events. At the signal 'Ready, Now,' a light (not bright enough to blind the partially dark-adapted *O* but sufficiently intense to illuminate the object adequately) was turned on for a few seconds. The time again was variable. There was no necessity for a strict control of time since it is not the interval which determines the amount and character of the apprehension. The instructions were:

I am going to show you something. Observe it carefully and report all the instances of apprehending of every sort.

In Series 4 with the same general set-up as that for Series 3, pictures were shown. A very simple exposure-device was used, which consisted of a piece of gray cardboard with a narrow ledge upon which to rest the picture and a larger piece of cardboard to cover the picture before and after presentation. The covering sheet was manipulated by *E*. About 10 sec. was allowed for presentation-time. The stimulus-objects consisted of 20 pictures of the campus and country-side surrounding the University, places with which all *O*s were familiar and had seen occasionally if not daily, and 15 pictures of scenes or events with which the *O*s were unacquainted. The instructions read as follows:

Observe the center of the card. A picture will presently appear. Report any occasion or event which comes with the presentation.

In Series 5, the same set-up and instructions were used as in Series 4. The stimulus-objects were the Rorschach inkblot figures.[20] The cards were presented in order as numbered, right side up, on the side, and upside down. *O* was allowed only 5 sec. to observe the figure.

In Series 6 musical selections taken from transcribed records were used. In order to eliminate distraction of *O* by passing outside noises and not to disturb the rest of the laboratory, the records were played in a soundproof room. The darkened condition of the room and the chair were the same as in Series 1 and 2. The musical phrases, 25 in number, covered a fairly wide range of musical forms, children's songs, popular dance-melodies and songs, folk songs, hymns, Cornell songs, and classical selections. Both voice and orchestra were used. The instructions were:

I shall play some musical records. It is immaterial whether you recognize them. I want you to report all apprehendings.

In Series 7 a number of noises were presented. Since it was discovered in a preliminary trial with *B* that these were uncertain occasions for remembering, only 15 were used. All were sounds common in the life of *O*. The stimulus-objects were

[20] H. Rorschach, *Psychodiagnostik: Tafeln*, (2d ed.).

presented in the sound-proof room under the conditions of Series 6. Instructions were:

A number of noises will be presented. Report all instances of apprehending both during the sound and after.

In Series 8 rhythms were presented. The experimental conditions were the same as those for Series 7; the same instructions were used. The rhythms were produced by tapping on a wooden table with a pencil, according to a set pattern.

## RESULTS

*The course of performance.* Now we come to the results obtained from the presentation of the described materials under the formal instructions to apprehend. The primary questions which we seek to answer are: How does the organism proceed with its task of apprehending? Does it follow a single fixed mode of performance? Does the quality of the operation depend upon the particular occasion and upon the kind of materials employed? We consider first the verbal materials (words and questions).

*Series 1. Words:*

Initial stage:

(A) Under the given instruction, the initial activity commonly (ca. nine-tenths of all observations) takes one of the *imaginational* forms. Following the comprehension of the word or words (the first stage in the following reports unless otherwise noted), there appears, in an imaginational mode, an example to represent the class-term, either specific or of general reference. Instances follow:[21]

Imag (gold pieces seen) (*N*, 1-50)
Imag (mimeographed form of student examination) (*D*, 1-41)
Imag (ballet-dancer dancing on stage) (*S*, 1-11)

(B) In a relatively small number of cases, comprehension was immedately followed by a *biographical reminiscence.* The rememberings were either single or in trains. Instances will make plain this form of reference.

Remem (yesterday's conversation about bookcases) > Remem (my bookcases in study) > Remem (library stacks just visited) (*N*, 1-26)
Remem (picnic last summer; rehearsal of events of day) > Remem (person mentioning picnic last week) (*R*, 1-43)
Remem (B dashing upstairs) > Remem (dashing vigorously into my study recently) (*N*, 1-35)

(C) The *initial comprehending stage may linger* by bringing other (explanatory or synonymous) words: then imaginations and memories follow in various sequences.

Comp ("manipulating") > Inspective comment (How do I use this word?) Remem (going over yesterday's notes) (*D*, 1-33)
Comp ("Oh, come all ye faithful") > Remem (choir singing at home) (*R*, 1-47)

[21] Parentheses following the name of the function involved contain the functional product. We shall abbreviate as follows: Remem = remembrance; Imag = imagination; Insp = inspection; Percn = perception; Comp = comprehension; SI = self-instruction. At the end of each report are given (in parenthesis) the *O*, the number of the series, and the serial item. Phasic changes of function are indicated by >.

Later stages:

(A) *Imagination continues* until the end of the performance, taking one of two forms.

(1) Imaginational images frequently change, thus gradually clothing the general term.

Imag visual (a peanut; then husk; then shell; then peanuts on sundae) (*D*, 1-46)
Imag (circle; then big red ball; then baby playing with ball) (*L*, 1-37)

(2) Successive imaginations present different meanings of the term.

Imag visual (a page in a book) Imag visual (a boy-page as in the hotel) (*L*, 1-6)
Imag (railroad train) Imag (someone training dogs in circus) Imag (streamlined train, interior) (*R*, 1-48)

(B) Initial imagining is followed by *more imagining, then by remembering.*

Imag (skillet) Imag (hands going precisely in some kind of factory work) Remem (knitting at tea) (*D*, 1-31)
Remem (K carving mouse at party) Remem (whole party) (*L*, 1-8)

(C) Initial stage (cf. A) is followed immediately by *remembering.* This is by far the most common procedure.

Imag (potato with bumps) > Remem (buying potatoes) > Remem (*O* calling apple potato in experiment) (*N*, 1-13)
Imag (sugar solution) Remem (candy just eaten) (*S*, 1-1)
Imag (running up hill) Remem (running to catch someone on hill) Remem (someone running to catch me) (*S*, 1-24)
Imag (snake twisting and turning) Remem (movie last night) (*D*, 1-3)

(D) After stages (B) and (C) performance follows one of the directions indicated under (A), (B), and (C).

An early completion (before 'Stop') or a blocking of function renewed (under self-instruction), or a comprehending of the spoken term. This was followed by another train of imagining and remembering. Here are cases of this kind.

Imag visual (a generalized bridge) > Remem (some bridge seen at indefinite time) Remem (Washington Bridge on occasion; as seen from boat last summer) SI to imagine: Imag (towers under construction in SF bridge) SI to remem (no product) (*N*, 1-21)
Imag (cotton) Imag (person walking softly) SI: other meanings? > Imag (very soft music) (*L*, 1-25)
Imag (country-side) Imag (tablecloth with luncheon) SI to remem > Remem (picnic several years ago) (*D*, 1-43)

*Series 2. Questions:*

Two circumstances led to a smaller apprehending output under interrogation than we achieved with words in Series 1. First, the questions specifically directed *O* to certain limited apprehensions; and, secondly, all the questions were posed in the past tense to increase the chances of *memorial* apprehension. We here desired to make instruction as much occasional and as little formal as possible. Another change was induced by shortening the time and thus breaking off the apprehensional trains.

Performance began in one of three ways: (1) by immediate imagining of something typifying either part or all of the question; (2) by immediate memorial reference to an event which would answer the question; or (if neither of these sorts of apprehending served) (3) by search for occasions which would satisfy the

conditions of the question. Once under way, performance went in the same general directions as with the words, *i.e.* a succession of rememberings or imaginings or rememberings and imaginings.

Imag (someone falling going down hill) > Imag (slipping and trying to catch your balance) (*R*, 2-23)
Imag (Ithaca station with train pulling in) SI to inspect question > Search (for an answer; no product) (*L*, 2-20)
Imag (little dog limping) Remem (occasion of discussing a dog as reported earlier) Remem (original occasion of dog incident) (*N*, 2-3)
Imag (black cat) (*R*, 2-36)
Remem (doctor coming to apartment a week ago) (Return to question and comment) > Imag (doctor's sign) (*N*, 2-43)
Remem (woman coming to house at Christmas) (*S*, 2-43)
Remem (noticing scar on knee last night) > Remem (falling down last summer) (*L*, 2-23)
Search (for female making annoying remark) > Remem (R making remarks this morning) Comment: ("This is not what I am searching for.") (*D*, 2-32)
Search > Imag (my cousin, who is fat) > Imag (a fat woman) (*S*, 2-12)
Search (for speech) > Imag (audience with speaker) > Remem (lecture this morning) (*D*, 2-14)

*Series 3. Familiar objects:*

Here small possessions, bits of well-known laboratory property and furnishings, and other objects designed to direct *O* toward his own personal history, were used.

This material greatly modified *O*'s performance. *O* typically began with a perceptive apprehension of the presented object. Then followed the functional forms illustrated below.

(A) Perception is succeeded by search carried on under self-instruction to discover the character, relevancy, or usual place of the object. The following cases proceed from the primary perception:

Comment ("no name") > Insp (such and such properties) Search (What is it?) (*N*, 3-5)
Percn (I know this) > Search (Where have I seen it?) (*S*, 3-25)
Search (to identify) > No issue (*D*, 3-28)
Percn (unknown animal) > Search (What kind?) (*R*, 3-10)

(B) Perception is followed by an imaginational or memorial excursion (or both). Examples are:

Percn (that sort of thing) > SI (make it familiar) Remem (on recent visit to P saw those materials) > Comment ("this thing not among them") (*D*, 3-10)
Slow percn > Flash (that sort of thing) Remem (saw it somewhere on a wall) Search (Where?) > Imag (going over *B*'s room, *J*'s room, *P*'s room) Comment (I think that it was *there*) > Remem (vague pastness of that place) (*D*, 3-18)

(C) Remembering succeeding perception and inspection.

Percn and Insp (pile of magazines) > Remem (first time I saw top one) (*L*, 3-19)
Percn (familiar object) > Remem (when it was made, when used, and later occasion when commented upon) (*R*, 3-11)

(D) Perception of object as belonging in a certain context; no single occasion and no specific memorial reference.

Percn (belongs in *B*'s seminary) (*S*, 3-2)

*Series 4. Pictures:*

Reproductions of familiar local buildings and scenes were shown to extend the memorial references obtained with the familiar objects of the last series.

(A) Perception (scene not identified) > Search.

Percn (creek and bridge) > Search (for 'whatness') (*N*, 4-13)
Percn (stream and setting) > Search (to identify; productless) (*D*, 4-13)

(B) Identifying perception followed by undated imaginational or memorial additions (or both).

Percn (campus chapel) > Comment (name) > Insp (spatial orientation) > Remem (flashes of views of the building) (*R*, 4-2)
Percn (library) Remem (several typical but undated past occasions there, passing by to lunch) (*R*, 4-6)

(C) Identifying perception followed by specific memories.

Percn (gorge) > Remem (I walked there the other day) (*S*, 4-13)

(D) Perception leads to topical development with comments.

Percn (woods-walk) > Comment ('this is G's walk') > SI (discover just where it is) Comments (series of remarks on place) Remem (I have been in such places) (*L*, 4-7)

Pictural reproductions of places and objects unknown to *O* for comparison with respect to memory and imagination were presented.

(E) Remembering directly or indirectly following perception.

Percn (people bicycling) > Remem (bicycling incident) > Remem (conversation about incident) (*S*, 4-26)
Percn (two figures with egg-beaters and bowls) > Insp (qualities of bowl) > Remem (use of bowl last night) (*D*, 4-29)

(F) Perceiving led at once toward imagining.

Percn (mother and daughter beating something in bowl) > Imag (beating batter) (*S*, 4-29)
Percn (house) > Search (for significance of scene) > Imag (house S built) Remem (card received) (*N*, 4-30)

(G) Topical development growing out of perception.

Percn (winter scene) Comment ("Poe's 'Bells' ") > Comments (topic of Poe's writings) > Remem ('Raven' in the movies) (*N*, 4-25)

*Series 5. Rorschach figures:*

Inkblot figures were presented in various positions. Here performance takes the directions indicated.

(A) Perception is followed by inspection and comment.

Percn (bear skin) > Insp (feet appear below) (*R*, 5-4)
Percn (nonsense blot) > Insp (no result) Comment ("possibly a neurological slide") (*L*, 5-9)

(B) Perception followed by imagination to be compared with object seen.

SI (find an object here) > Percn (kangaroo) > Imag (kangaroo) Search (is it an insect?) (*N*, 5-5)

(C) Perception was followed by remembering (3 cases only out of 88 presentations, aside from backward reference to earlier members of this series). An example is:

Percn (oriental idol) > Remem (motion picture of 'Green Goddess') (*N*, 5-21)

*Series 6. Musical selections:*

(A) Perception of music is frequently accompanied by a fictional excursion (im-

aginational accompaniment) with or without remembering. The task to identify frequently held the functional flow (preventing remembering and imagining?).

SI (do not identify but perceive) Imag (lacy paper, nosegay, silver filigree) (*L*, 6-15)
Imag (choir) Remem (going into chapel, one occasion) Remem (a dinner occasion) (*L*, 6-10)
Comment ("summer at camp") > Remem (copying song that day and other specific memorial occasions) (*L*, 6-20)

(B) Perceived musical product drops out and other apprehensions take its place.

Insp (tonal quality) > Remem (woman singing one high note) (*R*, 6-6)
Remem (series of specific memories concerned with dancing) (*N*, 6-5)

*Series 7. Noises:*

Noises, replacing melodies, greatly reduced the variety of performance. The noise offers a compelling occasional instruction to place and identify, which is commonly satisfied by apprehending (perceiving and imagining) the source of the sound. The activity is stereotyped, usually beginning with perception of the noise plus an imaginational accompaniment (visual) of an object or operation producing the noise. The accompaniment is so closely tied up with the sound as to be almost perceptual.

Percn (air coming out of a ball) + Imag visual (ball part of an atomizer) Percn (sound coming from a rubber toy) + Imag (such a toy) (*D*, 7-9)
Percn (pounding a nail) + Imag (wooden mallet striking a nail) (*S*, 7-5)

Identification, if immediate and suggestive of some event, as in the case of the ping-pong ball, may go directly into remembering.

Percn (a ping-pong ball bouncing—both auditory and visual) > Remem (typical occasions playing ping-pong and one specific occasion playing downtown) (*R*, 7-14)

Verbal comment and self-instruction are much less resorted to than with the pictures or melodies. They relate, when they occur, to the character of the object producing the sound.

Percn (something being rattled in a container) > Comment ("Don't know what it is but it might be dice in a parchesi game or a toy to test skill at shaking shot") Imag (round celluloid container with shot) (*L*, 7-4)

*Series 8. Rhythms:*

With rhythmical sequences of noises, *O* is concerned primarily with the character of the rhythmical object, the kind of pattern, its cohesiveness and vividness, and the grouping of the members. Perception of the rhythm is occasionally accompanied by visual imagination of musical score or a fitting occasion for a rhythm such as the one perceived.

(After second rap) > Percn (kinesthetic; breathing) + Imag (a series of single notes separated by rests on a page) (*R*, 8-4)
Percn (rhythmic pattern; sound of 'drip, drip, drip') + Imag (rain dropping into a water barrel) > Imag (picture of Chinese water-torture) (*L*, 8-4)

Remembering (except for 4 instances of memorial reference to previous rhythms in the series) occurred only 10 times out of 50 presentations. Performance is mainly perceptive; it is at times accompanied by inspection under task to identify pattern.

Percn (rhythm) > Insp (character of rhythmic form and temporal sequence) (*N*, 8-9)

Percn (pattern of taps) > SI (Is this repetition of previous pattern or variation?) > Insp (pattern apprehended as similar to one previous) (*D*, 8-5)

A summary will show more clearly the temporal course of the psychological activities from each series and the functional differences issuing from the various kinds of occasion.

*Series 1. Words*

| | | | |
|---|---|---|---|
| Comp | Imag | Imag<br>Imag<br>Remem | Imag<br>Remem |
| Comp | Remem | | |
| Comp | Comp | Remem, etc.<br>Imag, etc. | |

*Series 2. Questions*

| | | | |
|---|---|---|---|
| Comp | Imag | Imag<br>Remem | |
| Comp | Remem | Remem<br>Search | Remem or<br>Imag |
| Comp | Search | Imag<br>Remem | |

*Series 3. Familiar objects*

| | | |
|---|---|---|
| Percn | Search | Insp |
| Percn | Imag | |
| Percn | Remem | |
| Percn | Insp | Remem |

*Series 4. Scenes*

Familiar

| | | |
|---|---|---|
| Percn | Search | |
| Percn | Imag<br>Remem | |
| Percn | Topical | Comments |

Strange

| | | |
|---|---|---|
| Percn | Insp | Remem |
| Percn | Imag | |
| Percn | Topical | Comments |

*Series 5. Inkblot figures*

| | | |
|---|---|---|
| Percn | Insp | Comment |
| Percn | Imag | |
| Percn | Remem (rare) | |

*Series 6. Music*

| | | |
|---|---|---|
| Percn+Imag | | |
| Percn+Imag | | Remem |
| Percn | Search (to identify) | |
| Percn | Remem | |

*Series 7. Noises*

| | | |
|---|---|---|
| Percn+Imag | | |
| Percn+Imag | | Remem |

*Series 8. Rhythms*

| | | |
|---|---|---|
| Percn | | |
| Percn+Imag | | |
| Percn | Insp | |

*The functional nature of remembering.* We are considering as memorial those apprehensions of objects, events, and scenes, which carry a temporal reference to personal history. This obviously excludes those products of renewed and repeated performance which have lost, in the process of their acquisition, a time-reference which they may originally have had. It might be supposed that this definition would strictly limit the range of performance which may justly be called memorial. A more extended survey, however, will show that the variety of occasions distinctive enough for a true backward reference is considerable. The variety of temporal references, the presence or absence of context, and the richness of detail make it evident that the possibility of combinations and permutations of these aspects of the memorial product is very great. One of our primary tasks, then, has been to see whether, taking the large variety of remembered occasions producible under the conditions of experimentation, some orderly system of kinds and varieties is not possible.

The basis of such a classification is the first point of importance. The abundance or paucity of detail offers one possibility. Here, however, one would be forced to rely upon the extensive or foreshortened character of the product. This might mean that those things which happened long ago and are only sketchily remembered should be regarded as less memorial than recent events which can now be apprehended in greater detail; since it is probable that, with the passage of time, less important items drop out and only major aspects are remembered. This procedure would penalize those older memories for their mere remoteness of reference. This basis may be discarded because it seems to be a logical rather than a factual distinction.

Another possibility is the faithfulness of the remembered product to the original occasion. Here lie certain technical difficulties. Unless there is some means of knowing precisely the original conditions and what actually occurred in the original instance, it is impossible to tell how accurate the memory is. Philippe, Wulf, and others attempted to do this sort of thing and discovered various types of change. The types have been investigated and experimentally demonstrated. In all these experiments, however, one thing has been overlooked. This is the fact that, no matter how inaccurate or how changed from the original the event remembered may now be, so far as present remembrance is concerned the apprehension is wholly adequate and distinctive. When one attempts to give an exhaustive and concise description of the remembered scene, it is evident that many details have lapsed and have to be supplied from other sources. The memory, nevertheless, carries its own sanction. In other words, the accuracy or inaccuracy of the remembering has no effect upon the suitability of the memory. The person is unaware of most of the changes in the object or scene and is therefore content with the present apprehension of a former time. Even if it is completely wrong, as others may know it to be, it is, so far as the individual is concerned, a memory of *that time and occasion.*

The most natural classification is that based upon the temporal reference. Here we find a large range as between particularity and indefiniteness. This basis does not impose a reward or a penalty for precision and faithfulness or their want. Neither is there an undue emphasis upon remembered events of the recent past. Something which happened yesterday and something which occurred in high-school days may bear the same explicit reference, although in one case the details are multiple and more trustworthy than in the other. So far as the individual is concerned, both are explicit as to time and place. The question to be answered here in assigning a memory to its appropriate class is: How explicit or how vague is its temporal reference?

Since, moreover, many rememberings are always on the way toward the undated state, the specificity of the occasion is also important. With the remembering of an oft-repeated occasion, the particularity of time-reference is usually less than that of a single outstanding event. We must also consider this sort of variation, then, if we are adequately to compass the range and variety of rememberings. We shall have to designate the memory as specific, typical or generalized.

A word should be said about the 'dating' of remembered objects and events. To 'date' does not imply a reference to the calendar but rather to a concrete occasion as memorially given. To be sure, the occasion may hold a clue to a calendared event—for example, the remembrance of hanging holly wreathes may imply Christmas—but the memorial concreteness ("that particular occasion") need not contain any such clue. The calendarized reference is—as a matter of fact and as shown in our experiments—fairly rare where remembering is the only functional resource at a given time.

Let us explain further what we mean by the qualification of a memory as concrete and explicit or by the opposite qualification. We deal here with points or stations in a continuum. The two ends of this continuum, *i.e.* the explicit and the vague, are distinct enough. Between them we have varying degrees of specificity. In this regard no two memorial references are precisely the same. The particular and definite temporal reference is the sort of characterization of the product that one would find in remembering one's wedding, one's first day in high-school, a serious automobile accident, or the death of a friend. These things are apprehended as the time when 'that happened' or when 'I did that' or 'when I saw that.' The reference is to that incident or object at that particular time, and to no other. This type of reference is most common, not only under our experimental conditions but in everyday life where apprehending is of the memorial sort. In debate or conversation it comes out as 'the time we stole the dean's glasses' or 'the time I sold $20,000 worth of insurance,' or 'when I caught that 20-pound fish.' The occasion includes such things as the individuals present, the activity in progress, the setting, and the place.

In addition to this specification by occasion, such dating as of 'today,' 'yesterday,' 'recently,' 'when I was in college,' 'when I lived in Poughkeepsie,' and ' a long time ago,' may be added. This is generally accessory to dating by the particular occasion and may come as an answer to the question 'When was that?' It is important, however, as an adjunct to the occasion and may at times determine whether the reference is definite.

The explicitness of the temporal tag varies from this 'particular' type to apprehensions which are vague and indefinite in tense. The indefinite

type is much rarer, however, where remembering is of specific occasions or events. The event is here apprehended as having occurred 'sometime in the past,' possibly within a large stretch of time. An object may be remembered as 'that sort of project I was associated with then' or vaguely as 'some time or other I did that.' The occasion may be vaguely remembered, so that simply a tag of the original is left or the memorial product may be rich in detail but apprehended simply as 'something seen at some time' or as 'seen somewhere.' The dropping out of such relevant details as locale, specific nature of performance at the time, objects associated with a long period of time and no connection with any particular occasion, may lead to apprehension only vaguely and indefinitely placed. The best way of describing it is that the apprehension simply bears 'pastness;' more, that is to say, than familiarity of the product or knownness of the object, but the 'pastness' is of no particular time. In the first case, with the explicit reference, it is 'that time;' with the vague reference, it is 'some time or other.'

Having disposed of those 'one time' memories and the specificity or vagueness of their temporal reference, we still have to consider those apprehensions *of repeated performances* of the organism which have not yet wholly lost their temporal reference. Where the activity—perceiving, acting, or what not—has occurred a number of times, the separate occasions being more or less indistinct, the apprehension of them at the moment may take one of two forms. (1) The event is typical or representative of multiple occasions of the same sort, and it is apprehended as representative of the whole group but not of a specific instance. The apprehended occasion is taken as an example of the whole lot and stands for a number of like instances. (2) The memorial event may, on the other hand, be a composite of a number of like situations; it is apprehended as a generalized affair, incorporating the features of a number of times and thus standing for the whole group. Here, of course, the reference is not to one time or to 'one of those times,' but is simply a regional reference. The temporal reference for the typical and the generalized memories is the same.

The next and last step in the direction of loss of dating comes with the typical or frequently-met-with object which still retains a slight temporal reference. Here the reference is a vague pastness, similar in character to the indefiniteness which may accompany specific events, as discussed above. The apprehension here is 'this occurred' or 'I had this.' The memory may again be regional in its pastness as 'the sort of thing which has been accustomed to happen.' Sometimes the period of time enclosed is known in other ways and may be supplied logically, as 'it happened only during that period so it must have been then.' The actual time, however, is simply a vague pastness.

To step out of memory is to apprehend without a 'tense' limitation of any sort. This loss of tense comes with events, scenes, or objects which are simply 'known' as they appear at a given moment; 'that is the way it has been and is' and 'that is the way it looks or happens under such circumstances.' Here characteristic attitudes or activities of an acquaintance may be the apprehended object. These are 'stock-type' apprehensions. They may be separated from imagining only for purposes of exposition. The difference is in the 'knownness' of the product rather than in the time specification. The next-to-memory form differs from imagining of the 'isolated' type in that it is something which has occurred or been perceived many times and has lost the temporal reference. The isolated 'fictional' imagining is something which is produced by the organism at the moment to typify a state, object, mood, or situation which—whether previously apprehended or not—has no internal temporal reference.

We may now define our four main memorial types;

(I) An occasion or event which bears a particular and explicit temporal and autobiographical reference.

(II) A specific event or scene which bears a vague and indefinite temporal and autobiographical reference.

(IIIa) An event typical of multiple occasions apprehended with a definite but not specific (as of a given occasion) past reference.

(IIIb) A generalized object or event, a composite of a number of similar occasions, apprehended with a temporal reference to a general period of time.

(IV) A typical event or scene apprehended as 'this occurred' with vague temporal reference and context.

A few examples of the various types may help to make clear the distinctions among them.

*Remembering. Type I:*

Remem (discussion a few weeks ago about disliking and liking of oatmeal) Reinstatement of scene, comments, etc. (*R*, 1-32)

Remem (seeing a train today) > Remem (seeing a train last summer which passed us in the middle of the night in the wilds of Wyoming) (*L*, 1-48)

Remem (psychological examination this morning) > Remem (B doing examination a moment ago with lots of detail) (*N*, 1-41)

Remem (father riding horse last time I was home; he was riding up the driveway) > Remem (one time when my father had the horse out with several colored men showing them its points) Imag (riding in automobile) > Remem (two years ago on Thanksgiving when friends were home with me and we took a drive—detailed) (*S*, 1-3)

Remem (incident when dog got up and walked to front of room and X escorted him out) (*D*, 1-5)

*Remembering. Type II:*

Remem (general, of something in past on my uncle's farm carried mainly by picture of a potato field) (*R*, 1-13)

Remem (toy duck the baby had last year, no particular time) (*S*, 1-15)

Remem (particular cat, quite detailed; dating itself obscure; past but not definite) (*N*, 2-36)

Remem (some time this fall I fell and bruised my knee; vague temporal reference, just pastness) (*D*, 2-23)

Remem (story of L madly packing a suitcase; indefinitely dated, just remember I have heard it once) (*L*, 1-49)

*Remembering. Type IIIa:*

Remem (race between leaders when I was in camp; races held every month and I won them on several occasions; typical, visual, and dated sometime during two summers I was there) (*S*, 2-19)

Remem (first place I saw the book; remembering of typical kind; saw it every week; no specific occasion but temporal reference to a particular year) (*L*, 3-22)

Remem (typical of C's study with milk bottles; just a past reference) > Remem (typical occasion during time when I didn't use my eyes of eating in a darkened room) (*R*, 3-6)

Remem (typical drinking out of such a cup in kitchen last few days; no particular occasion) (*D*, 3-23)

Remem (little carnations on tables in tea room seen and discussed frequently when I used to eat there) (*N*, 2-30)

*Remembering. Type IIIb:*

Remem (generalized buying cigarettes at store; dating non-specific) (*N*, 2-8)

Remem (when I was young going through woods trying to imitate Indians; not definitely dated, a composite of a number of occasions of the same sort) (*R*, 1-19)

Remem (walking across there in spring from dinner; generalized remem but definitely past) (*S*, 4-8)

Remem (sitting playing musical themes time after time preparing for music examination; generalized remem of a number of times) (*L*, 6-12)

Remem (baby at P's house; no particular occasion, just past on several occasions as I saw it; it was a sort of composite) (*D*, 3-14)

*Remembering. Type IV:*

Remem (cartoon of figure which *Judge* used to represent, Father Blue Laws and silk hat being hit by snowball; carried vague pastness) (*N*, 2-49)

Remem (dog with part of leg amputated by a mower; vague past reference; I have seen numbers of dogs with part of leg missing. No particular dog but a dog typical of this occasion of getting tangled in mowers) (*D*, 2-3)

Memories are not always static products. Under self-instruction or with unlimited time, they may shift and change in two directions.

*(1)* They may emerge from a generalized form (IIIb or IV) with indefinite dating into a precisely dated occasion (I). Here are instances.

Generalized remem (listening to music) > specific remem (listening to Sibelius at P's) (*N*, 2-13)

Generalized remem (train-rides back and forth from school) > filled out by remem (particular train-ride with a friend) (*S*, 2-20)

Remem (occasions playing ping-pong) > remem (specific occasion playing) (*R*, 7-14)

Generalized remem (Washington Bridge) > specific remem (bridge as seen from boat last summer) (*N*, 1-21)

*(2)* They may flow out of imagining into various kinds of remembering. Instances are:

Imag (picnic with people eating) > Imag (people eating at a particular place) > Remem (a picnic at that place; more details kept coming in; precisely dated) (*S*, 1-43)

Imag (number of legs running) > Remem (athletic meets in Lincoln) (*D*, 1-24)
Imag (people dancing) > Imag (people in German costumes dancing) > Remem (German dance I went to) (*L*, 5-2)
Imag (someone playing saxophone, no particular person) > Remem (typical scene with friend playing saxophone) (*R*, 6-20)
Imag (oriental room hung with tapestries) > Remem (oriental room from particular movie) > Remem (other parts of that movie) (*D*, 6-14)

Let us consider the relative frequency of our varieties of memorial apprehension as produced under our experimental conditions (Series 1-8). When we include the results of all *O*s and determine the percentage of reports of each sort for every series, we derive the following table.

It will be seen at a glance that the most frequent variety of rememberings in every series is that of Type I, occasions with an explicit temporal

TABLE I

FREQUENCY OF TYPES OF REMEMBERING
(percentages)

| Series | Types of remembering | | | | |
|---|---|---|---|---|---|
| | I | II | IIIa | IIIb | IV |
| 1. Words | 70 | 11 | 6 | 5 | 8 |
| 2. Questions | 77 | 7 | 4 | 6 | 6 |
| 3. Familiar objects | 71 | 5 | 14 | 5 | 5 |
| 4. Pictures | 66 | 5 | 11 | 13 | 5 |
| 5. Rorschach figures | 75 | 8+ | 0 | 8+ | 8+ |
| 6. Music | 67 | 6 | 9 | 13 | 5 |
| 7. Sounds | 60 | 7 | 14 | 19 | 0 |
| 8. Rhythms | 70 | 10 | 0 | 10 | 10 |

reference. In this group are included not only those with a temporal reference to a given day in the recent past but also more remote events which are just as particularly dated by the occasion. Types II and IV are least frequent, a fact which seems to indicate that those things which lose their specificity, for whatever reason, commonly lose their past reference altogether. When the time is retained, it is more likely to remain as particular to that occasion or that type of occasion, rather than as vague pastness.

We may next ask whether the kind of temporal reference varies with the type of inciting material. It was hoped that, under incitement from words, the whole range of apprehending would be represented. This hope was realized, but the tendency for the massing of the memories at the specific end of the scale (Type I) is indicative of the whole mass of our materials. With the questions, the use of the verb in the past tense was intended to direct the organism more directly backward. Here again, however, we find the same general tendency as in remembering from words. With the familiar objects, it was expected that a preponderance of memories of Types IIIa and IIIb would result. This turned out not to be the case.

The percentage of IIIa is somewhat larger than usual, to be sure, but not significantly greater. In Series 4, with the pictures of familiar places in the vicinity (which accounted for 91 of the total 163 rememberings in this group), we derive the following percentages.

| Memory | Campus scenes | Strange scenes |
|---|---|---|
| I | 67 | 65 |
| II | 5 | 5 |
| IIIa | 9 | 13 |
| IIIb | 18 | 7 |
| IV | 1 | 10 |

The difference between the two groups is not striking. There is a slight advantage in favor of the familiar scenes of Memory-Type IIIb, and of the unfamiliar in Type IIIa. The 10% in Type IV for the strange scenes is largely accounted for by one *O* (R) whose reports supply 7/10 of this total.

When these meaningful scenes are compared with the Rorschach figures (Series 5), we find again the predominance in favor of Type I. Here, however, the percentages are misleading. The total number of rememberings for Series 3 is 162; that for Series 4 is 12. Throughout the whole range of materials, the same tendency holds true.

A better basis for judging the efficacy of the various kinds of material in inducing apprehension of the memorial sort is furnished by the total number of memorial reports which fall in the several groups.

| | | | |
|---|---|---|---|
| Words | 281 | Rorschach figures | 12 |
| Questions | 226 | Music | 112 |
| Familiar objects | 154 | Sounds | 42 |
| Pictures | 162 | Rhythms | 10 |

It can be seen at once that ink-blot figures, sounds, and rhythms are very ineffective as occasions for remembering. The total memories with sounds (42) are considerably increased by a device of *N* who self-instructed himself, when the occasion was memorially ineffective, to search for a memorial reference. The other *O*s averaged about 6 memories each with sounds.

It was thought that there might be some difference in the mode of remembering with the various grammatical classes of words. To this end, we analyzed by parts of speech. There is a slight advantage in favor of nouns and past participles.

| Verbal class | No. words (%) | Memories (%) |
|---|---|---|
| Nouns | 32 | 36 |
| Adjectives | 26 | 20 |
| Verbs | 22 | 27 |
| Adverbs | 20 | 17 |

The general tendency of all *O*s (noted above) is present and consistent when words of the various classes are considered. There is a slight but consistent relative decrease of Type I reports from nouns (78%), through adjectives (70%) and adverbs (66%), to verbs (63%), of the total reports. With the verbs we find the largest number of Type IV memories. It seems altogether likely that a careful choice of the verbal occasions might lead to a still heavier weighting of the memorial references.

Something may be learned from an inspection of the presentations to which no memorial response whatever was given. Out of a total of 250 words, no rememberings were reported for 48. Among the parts of speech these were distributed as follows: Nouns (13), adjectives (17), adverbs (12), and verbs (6). Two *O*s accounted, however, for practically four-

| Material | Reports | No. omissions | % omissions |
|---|---|---|---|
| Words | 250 | 48 | 19 |
| Questions | 250 | 62 | 25 |
| Pictures | 175 | 52 | 30* |
| Familiar objects | 150 | 41 | 27 |
| Music | 125 | 50 | 40 |
| Rorschach figures | 88 | 76 | 86 |
| Sounds | 75 | 46 | 61 |
| Rhythms | 50 | 39 | 78 |

* No difference between campus scenes and strange pictures.

fifths of the omissions: D with 22 and L with 16. The performance where no rememberings occurred typically went in the direction of imagining. D used a peculiar procedure. He was primarily concerned with verbal meanings and was likely to embark upon a topical survey of the objects, actions, and so on, implied. L and the other *O*s, as a rule, filled in the memorial omissions with imaginings.

For the various kinds of material, the following list will show the frequency of omissions in the various series.

It will be evident at once that the most effective occasional incentives for remembering were our words, questions, familiar objects, pictures, and musical selections. With the ink-blot figures, *O* is primarily set to apprehend an object in the figure and to this end inspects. With sounds, the concern is identification of the source of the sound; and with rhythms, *O* is engrossed in perceiving. The questions were more productive of rememberings than any other kind of material used. Had *O* been permitted to continue with the performance for as long as was allowed with the words, it is likely that a larger number of memorial reports would have resulted. The reason for this efficacy of questions in calling up memories is not hard to find. This sort of occasion approximates more closely

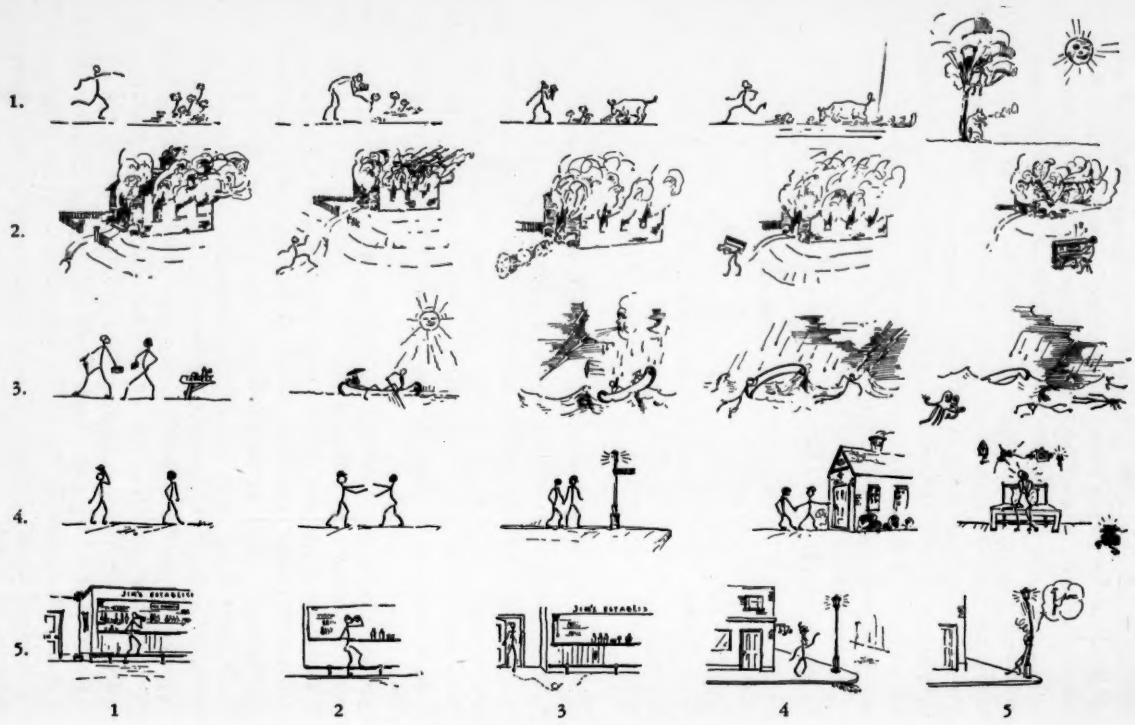



FIG. 1. MATERIALS USED IN PART II

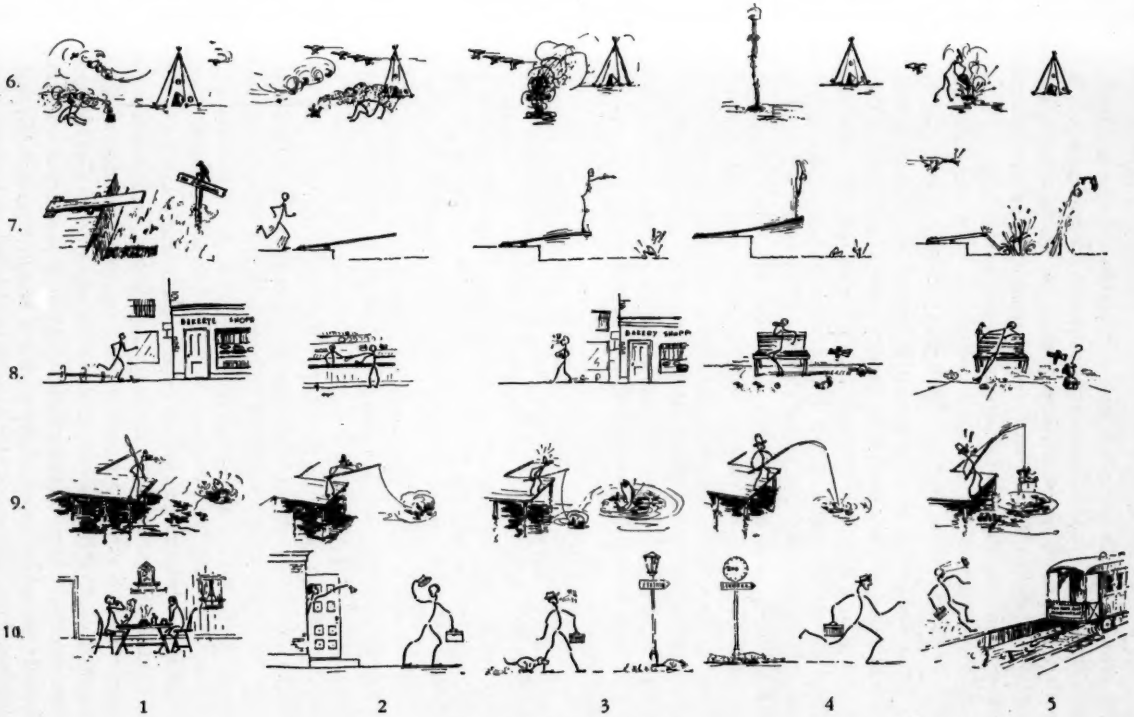



FIG. 2. MATERIALS USED IN PART II

the situation in daily life which leads to apprehending of a memorial sort. Here there is a definite occasional instruction to go backward. Without either an occasion or a self-instruction of this sort, apprehending may go in any direction, or the course of performance may leave apprehending entirely and proceed toward more complex functions.

## PART II

To ascertain the kind of performance induced when new materials are presented in a coherent series to be run through cumulatively by *O* and then recovered as a whole, we prepared 10 groups of pictures, with an additional set for the preliminary trial. Each group of pictures contained 5 drawings, showing successive stages of an event (Figs. 1 and 2). Most of the 'stories' were conventional, although in a few the ending was out of the ordinary. The group was presented, picture after picture, each shown about 2 sec. At the end of each group *O* reported upon the course of performance, after which he was instructed to sketch roughly with his pencil one picture at a time and in the original order. *O* then reported upon psychological activities during the recovery and the sketching. The instructions were as follows:

I am going to show you a number of pictures one after another. When I have finished, report upon the whole group. (After the report): Sketch down here (indicating a sheet of blank paper) the main stages in order.

*O* was informed that excellency of drawing was unimportant and that details were not essential. Since the figures were simple line-drawings, no difficulty in sketching was realized. *O* was allowed as much time as he required.

*Performance at the presentation of the pictures.* With the first card there is simple perceiving and inspecting. Even in the preliminary group, the first picture was apprehended as a scene. When the second card came, occasional instruction gave to *O* the ligated succession within the series. With the progress from member to member of the group, the narrative or topic grew (as in the comic strip of the daily paper), and with the last picture the narrative was usually completed and closed. After the first picture or two, inspecting became limited to the more pertinent details unless occasion or self-instruction set some collateral task regarding the relevance of a detail. When the topic was not set immediately, there was search for significance and various possibilities were examined and discarded. This was well illustrated by Group 6, where the narrative was somewhat obscure, irrelevant details clouding the main point. Where the topic was satisfactorily set and the course of the story was imaginationally anticipated, *O* simply perceived the import of the pictures which followed, noting whether

or not they realized his anticipated development of the story. This topical part of the procedure primarily called for comprehending, *i.e.* the relations between and among the successive views and the stages of the narrative were 'understood.' First perceiving, then, secondly inspecting, and thirdly this comprehending with search for a satisfactory significance which would integrate the whole series. Search, finally, led to a sharper inspecting where significance lagged. Comment (as in giving titles to the pictures) and flashes were devices sometimes added.

The following samples taken from the reports will illustrate the psychological course while the pictures were under scrutiny.

Percn (picture) > Insp (details) Comment ("house burning"). *Second picture:* Insp > Comment ("the burning house is the same") > OI (inspect for differences from picture 1) Insp (man running toward house). *Third picture:* Comment ("He runs into burning house; now he is in dangerous spot. What is going to be the outcome of it?"). *Fourth picture:* percn (man carrying something out of house) > Insp (key-board arrangement but no object). *Fifth picture:* percn (man outside playing piano) > Comment ("Oh, that is what he was carrying out") > Remem (object as shown in picture 4) > Comp and Flash (this is similar to Nero's fiddling as Rome burned). (*D*, 2)

Percn (bakery shop and misspelled sign) Task ("What is wrong with spelling?") > Insp (extra 'e') > Comment ("Maybe this was an old fashioned way of spelling bakery") Insp > Comment ("boy going to the bakery"). *Second picture:* Percn (inside of bakery) > Insp (bread passing from baker to boy). *Third picture:* Insp (bakery spelled right here) Percn and Comment ("Boy is leaving the shop") Remem (sign in picture 1). *Fourth picture:* Remem (signs in pictures 1 and 3) > Comment ("Was the first one really wrong? Yes, I am sure it was") Insp (boy eating bread sitting on bench and little squirrel looking at him across the path) > Comment ("Yes, there is a sign in this picture 'Keep off the Grass' "). *Fifth picture:* Insp (boy asleep, bread on path, squirrel and bird on grass). [*Note:* There was no anticipation of what was to come. The whole thing as a narrative was not particularly integrated partly because of the continued memorial reference back to the sign and partly because there wasn't anything that would indicate what was going to happen and no particular turn to the story.] (*L*, 8)

Percn > Comp (strong implication of a scene from earlier set). *Second picture:* Percn and Flash (this follows from the other) > Comment ("How will it go on?"). *Third picture:* Integrated with first two percns > Flash (something new comes in) > Insp (cow) > Comp (still stronger narration) OI (to inspect next scene). *Fourth picture:* Comp (so this is what happened then) Percn (figure in tree) Comp (entire series of events) [*Note:* At no time was there a departure from the scene but a very beautiful change first toward inspecting and a gradual unfolding of the significance of the whole series with an increase in comprehending. The finality of the last term was decided. The thing was done, it had come out. There was no imagining or remembering.] (*B*, 1)

*Performance at the time of recovery of the series.* Since it is generally assumed that relating a preceding event is accomplished primarily by memorial means, it was expected that instruction to recover the figures in order would set the stage for this function. It was found, however, that a memorial reinstatement of the pictures was, in many cases, too fragmentary to serve adequately as a basis for the drawings. Here memorial reinstatement was assisted by comments and flashes, verbal recital of the story during

the drawing itself, and inspecting for consistency as the sketching went on.

The fruits of a primary comprehending were clearly used to 'express' the narrative in the successive sketches. At times an object or aspect of the situation, which carried the meaning of the picture (a part standing for the whole), was the only thing remembered, the rest being filled in either from the story as a whole or imaginationally. Typical examples of our 50 reports follow.

*Group Scene*

10 1. Remem (details under title: breakfast scene)
2. Search > Remem ("Man leaving home") [Details unsatisfactory; sketch of implications of title: little of original drawing remembered except relative positions of two individuals]
3. Comment ("suburbanite") > Remem (man walking toward station with dog running beside) > Search (for details; fruitless) [Note: drawing symbolic of verbalization]
4. Comment (man sees clock, runs). [Practically no remem of details]
5. Remem (position of train and man) [Drawing highly symbolic, details largely referential to verbalization] (*N*, 10)

9 1. Remem (fishing pole over man's shoulder; detail not clear) > Comment ("There must have been water")
2. Remem (line in water; nothing else clear, not even position of man)
3. Remem (large fish and position) > Comment ("Don't know what the man is doing; the dock must be there and he must be on it")
4. Remem (pole bent) > Comment ("man must be leaning back and pulling")
5. Remem (large shoe in some detail) > Comment ("Man must look disappointed") [Note: nothing clear in picture except shoe] (*L*, 9)

4 2. Remem (lamp lighted and so at night)
3. Remem (red brick building) > Remem (individuals going to house; details not clear)
4. Remem (individuals sitting on long thing like a davenport; drawing it with curved back but don't remember whether it was or not) > Remem (clock and cracked wall and picture) > Comment ("they had their arms around each other") Comment: "I have evidently left one out; I don't know which one it was. As far as I had a story it is right there.") Remem supplemented by comment (*S*, 4)

1 1. Remem (flowers and attitude of man but not details) > Remem (man's head specifically as bunch of lines without much meaning)
2. Remem (individual picking flowers; no details because in original presentation concerned with insp of head)
3. Remem (person to left simply as gray blob) > Remem (bull with breath coming out of his nostrils)
4. Remem (individual running) Remem (bull as gray blob)
5. Remem (bull looking threatening) Comment ("Remember more or less whole situation in the picture. When it comes to recalling details these things which I have tried to sketch more in detail (tree, man, bull, sun) were the things which stood out. Gray blobs were things involved in the total situation: just recall objects were there; no detail"). (*R*, 1)

7 1. Remem (no swimming sign) > Comment ("It must have been on something but don't remem") Remem (diving board over pool)
2. Remem (figure approaching diving board)
3. Remem (figure on diving board and fish with question mark)
4. Remem (diving board in motion) > Remem (figure as gray blur above board)

5. Remem (splashing water and fish in air) > Remem (figure somewhere in splashing water) Comment ("Part of figure was showing; shall draw posterior half") Comment ("There were lines indicating path down in diving, I believe") (*D*, 7)

9 1. Remem (wharf, man, fishing, and fish) > Comment ("original figure much more detailed") Flash (not important)
2. Search (no product) Action (figure drawn practically as a repetition of the first figure) Comment ("Second drawing of the original series did not particularly elaborate the topic of the first")
3. Remem (fish jumping out of water, most significant detail) > Comment ("Man, fish-pole, etc., simply repetition")
4. Comment ("A strike") [*Note:* This again simply the most significant detail of the earlier apprehension and developed the topic initiated by first and third]
5. Comment ("Old shoe") Search (no product) [*Note:* As far as the whole performance is concerned the first and fifth drawings are taken as representative of the group, and the second, third, and fourth merely as incidental or even unnecessary. In other words the first and fifth carry the meaning of the whole] (*N*, 9)

As one *O* reported in a preliminary trial, the resources used to make the drawing were a curious mixture of remembering and of schematizing central elements in the narrative. The drawing is built around these elements, and additions are made from the story as a whole, by way of comment and the way 'it should be to fit the narrative sequence.' Here comprehending is obviously brought in to aid and supplement remembering. There is evidence also from our other series that this commonly occurs in the relating of a memorial event.

What happens is simply this. The event in the original instance is comprehended as well as perceived; the significance of the various stages is built up as the perceiving progresses and the story is integrated into a whole. The significance at the time of recall is carried memorially by a small part of the original. The rest of the event is filled out or pieced together from the meaning of this original fragment. At the time of recital, this small part is enlarged upon, and extended by comprehending and imagining. Gaps are filled in and details added. Where the story is well integrated, there is at the time of recovery a running through of the narrative and separation into frames or stages of the event. The significant detail apprehended in the original picture serves to mark it as that picture and the rest of the drawing is made with reference to its place in the story and in the general situation, *i.e.* as represented by the significant detail.

The integration of the narrative is illustrated particularly well by those groups in which *O* either omits a picture or consolidates two into one. Here the narrative is as complete as it was in the presented material. One picture has been regarded as unnecessary to the main steps of the story and hence is disregarded. The omission is not generally realized by *O* until the

end of the drawing. The recovery has been primarily in terms of the products of the original comprehending and is therefore completely represented in the drawing. The story is told; if the recital is not in the same form as the original, it is immaterial. It is still the same story. After the first one or two figures in the original group, emphasis is not upon inspection of details of the whole figure but rather upon those things which extend the topical development initiated by the first one or two views. It is easy, then, to see how the recovery depends upon the significant details of succeeding pictures as these are essential to the completed narrative.

That much which has formerly been called memorial is a combination, as in this series, of the products of comprehending and remembering is at once evident. A small part of the original instance is remembered. This small part is symbolic of the whole event or scene. When recall occurs, there is built up around this detail the story of the original event. Its significance is extended and enlarged upon until it is a complete event. There is much more use of the products of comprehending and symbolization in what has been assumed to be memory than has previously been pointed out.

The main issues of this serial presentation of pictures are two. Both are important for our study. The first is the serial ligating of successive perceptions where there is a consolidation of the perceptive products through inspection and comprehension. The 'views' are many; but their significance is one. The scenes presented become *stages* in a single sequence. They take a *story* form, as in the comic strip. Our reports have shown how perceiving, inspecting, and comprehending are employed—with help here and there from flash, comment, and self-instruction—to produce the 'narrative.'

The raw materials appear, of course, in the occasion, *i.e.* the succession of line-drawings which tip off the organism, in the ways just recited, toward a final accomplishment.

The second issue of this series is the functional integration, under the formal instruction to recover and depict, of remembering and imagining with the products of comprehending. Of the separate recovery of Scene 1, or Scene 5, or Scene 3, used as a basis for the drawings, there is relatively little. The drawing is a well-automatized action *incited,* as a rule, *by the narrative.* Remembrance and imagination are both accessory, coming in either to supply furnishings and parts for the scenes or to correct and amplify the narrative. The subordination of these functions was made evident by the comment of an *O* that he could not say whether there had been three, four, or five scenes in the series, although the narrative and its outcome were clear. Scenes, again, were confused and telescoped at times, albeit the cumulative result of them was prompt and unequivocal.

The importance of these issues is enhanced by the fact that operations of just this sort, which are extremely common in daily life, are invariably set down crudely as typical cases of 'memory,' whereas real remembrance plays in them a decidedly subordinate rôle.

A refined and complete description of the precise way in which the products of comprehension are used on such occasions as ours, in these experiments, remains a problem for the future.

## Conclusions

Before we come to a final estimation of our results for memory we must glance at the whole group of apprehensional functions to see how the various forms of remembering stand related to perceiving and imagining.

The natural starting point is perceiving. While perceiving always bears the stamp of the present, we must not make the mistake of considering it as a static die impressed upon a world of objects. Perceiving runs its course as truly as acting, thinking, and the other functions do. Its course is most easily realized in such fluent perceivings as melody, rhythm, the apprehension of movement, and the running of the eyes, in an exploratory way, over a picture or landscape. This temporal progress of perceiving within the single occasion makes it clear that the before and the after, the earlier and the later, the placing of the event in a temporal order, are fundamental to this sort of organic operation. The temporal coefficients and placings in perception also help us to understand the large part played by tense and time in memorial review and in imaginational anticipation.

Experiment has made it obvious that in a melodic or rhythmical sequence each succeeding member has its own character and its own place in the total configuration, at the limit of which we have, on the one extreme, those members which fall earliest in the whole pattern and which have just beyond them the memorial echo. These 'just past' parts of the apprehensive series shade off into the true memorial reconstitution of the recent past, and these again into more remote remembrances. At the other extreme of perceiving we have anticipative prophecies which extend the present to the not-yet in very much the same way as the memorial echo extends the plane of the present to the just past. This anticipative extension leads then naturally into detached futurity, which has the same range of future times as remembrance and recollection have for past times.

If we add, then, to these temporal coefficients, which begin in perceiving and extend in both directions, the qualifications of generality and specificity, of definite and indefinite dating, and of precision and vagueness of reference, we shall have covered—in the one direction—practically the whole

range of memorial variety which we have actually discovered and identified in the reports of our various series in Parts I and II.

Since our interest centers in the memorial varieties, we shall not carry further the implications of perceiving and imagining, and, as regards remembering itself, we have only to summarize the general results of our experiments. In order to show these internal relations within the entire family of apprehendings, however, we have set down, primarily for the sake of our memorial orientation, the main forms of perceiving, imagining, and remembering.

| *Remembering* | *Perceiving* | *Imagining* |
|---|---|---|
| (1) Echoes of the just past | (1) Primary perceptive course, with temporal coefficients | (1) Anticipative completion of perception |
| (2) More remote dating<br>(a) Definite and specific<br>(b) Generalized<br>(c) Typical<br>(d) A temporal region | (2) Extension of 'present;' varying degrees of specificity among 'present' members | (2) More remote anticipation<br>(a) Definite and specific<br>(b) Generalized<br>(c) Typical<br>(d) A temporal region |
| (3) Undated<br>(a) Vague reminiscence<br>(b) Familiar (as 'having been') | (3) Generalized and abstractive perceiving | (3) Undated; detached ('free' and 'creative' imaginations; fictions) |
| (4) Memorial accessories to perceiving | | (4) Imaginational accessories to perceiving |

In reviewing the history of memory at large, before gathering our own experimental facts, we discovered that the term had been used ambiguously to designate a number of psychological processes, operations, and abilities. The interpretation of our own experimental reports brought out the following conclusions.

*(1)* When 'memory' is carefully used to mean *remembrance* only, *i.e.* one of the primary modes of apprehension, it still presents a number of varietal forms, forms standing related in a wholly definite way both among themselves and to the other great groups of apprehension, perception and imagination.

*(2)* When occasion and formal instructions leave the organism free to apprehend, practically all of the modal varieties of perceiving, imagining, and remembering may be identified and distinguished in the reports of the trained observer.

*(3)* When the organism is presented with a series of related occasions

which call primarily for integration of the entire series (as in our 'narrative' pictures of Part II), the memorial references are very much scantier and more infrequent than psychologists have generally assumed, the typical substitution for memory being a form of comprehending which reconstructs and interprets individual scenes as stages in an integral narration.

*(4)* True remembrance, in its various forms, may be incited by a great number of occasions, the character of the remembrance depending to a certain extent upon the character of the inciting agent, whether the agent be a word, question, picture, possession, or melodic phrase.

## APPENDIX

### Series 2. Questions

1. Was the hill slippery?
2. Did the sauce have onions in it?
3. Was the little dog limping?
4. Was the steak burned?
5. Were the peanuts salted?
6. Was the book in the library?
7. What sort of music did they play?
8. Did you have enough money to get the cigarettes?
9. Was the strange man bald?
10. Did the thunderstorm frighten you?
11. Was the saucepan burned?
12. Where did you see the fat woman?
13. Did the orchestra play off key?
14. Were you bored with the speech?
15. Was the fire serious?
16. Did she wear a long dress?
17. Was the coffee weak?
18. Did the rain spoil the picnic?
19. Did you win the race?
20. Was the train-ride tiring?
21. Was anyone killed in the accident?
22. Was the swimming pool large?
23. Did you hurt yourself when you fell?
24. Did you see the train-wreck?
25. Did you find the pencil?
26. Were there camels in the circus?
27. Were the pictures oils or watercolors?
28. Were the new shoes too tight?
29. Did you win the bridge prize?
30. Were the flowers roses or carnations?
31. Who won the fight?
32. Did her remark annoy you?
33. Was the soup very hot?
34. Did the dress have to be cleaned?
35. Were you embarrassed when the drink spilled?
36. Did you blame the bad luck on the black cat?
37. Was the watchman surly?
38. Was the stairway tiring?
39. Were you very sick when you had the mumps?
40. Did the food make you sick?
41. Was the football game exciting?
42. Was the book historically accurate?
43. Was the doctor encouraging?
44. Was the lobster cooked well?
45. Did the package arrive safely?
46. Did the car have chains on it?
47. Was the story amusing?
48. Did you catch the poison ivy?
49. Did the snowball hit you?
50. Were the falls as beautiful as you expected?

# PERCEIVING AND SYMBOLIZING: AN EXPERIMENTAL STUDY

By WALTER S. NEFF, University of Maine

Although most psychologists have recognized that the human organism carries on, from time to time, more complicated activities than those commonly implied by the terms perception and action, experimental evidence bearing upon these 'higher mental processes' is far from satisfactory. That is not to say that psychologists have made no attempt to solve these problems, nor that the problem of the more involved psychological activities is new to experiment. Historians are wont to agree that Ebbinghaus was the first to "open a breach by experimental psychology in the barrier about the 'higher mental processes'."[1] The publication of his *Über das Gedächtnis* (1885) is usually given as the birth-date of experimental studies beyond the simpler processes. We shall not here engage in a controversy as to whether Ebbinghaus was really first in this field of experimentation. Suffice it to say that his brilliant work in 'memory,' taken in the sense of serial learning, incited psychologists to approach the 'intellectual processes' by controlled observation and measurement.[2]

An extremely serious and elaborate attempt to submit these 'higher' performances to experimental investigation was that made by the researchers of the Würzburg 'school' under the leadership of Oswald Külpe. These studies of thought (the term they gave to all intellective activities beyond mere apprehension and memory) carried on by Ach, Watt, Messer, Bühler, and others during the first decade of the present century, constitute an effort to transfer to this realm methods which had been developed in the investigation of sensation, perception, and action.[3] A critical

* Accepted for publication May 20, 1936. The study was carried out in the Psychological Laboratories of Cornell University under the direction of Professor Bentley.

[1] E. G. Boring, *A History of Experimental Psychology*, 1929, 381. Philosophers have long been accustomed to make a division between 'lower' and 'higher' activities. The opposition of 'sense' and 'intellect,' 'sensation' and 'cognition,' and 'passive' and 'active' in the mind exerted an influence on many aspects of 19th century psychology. The overwhelming authority of the doctrine of association has been weakened only recently.

[2] We should not overlook mental chronometry and other studies in Wundt's newly established laboratory. Among these studies stand M. Friedrich, Über die Apperceptionsdauer bei einfachen und zusammengesetzten Vorstellungen, *Philos. Stud.*, 1, 1883, 39-77; N. Lange, Beiträge zur Theorie der sinnlichen Aufmerksamkeit und der activen Apperception, *ibid.*, 4, 1888, 390-422, and E. B. Titchener, Zur Chronometrie des Erkennungsaktes, *ibid.*, 8, 1892, 138-144. A critical estimation of this work may be found in O. Külpe, *Outlines of Psychology*, 1895, 415 ff.

[3] The best known of the studies issued by the Würzburg group are N. Ach, *Über die Willenstätigkeit und das Denken*, 1905, 1-294; H. J. Watt, Experimentelle Beiträge zu einer Theorie des Denkens, *Arch. f. d. ges. Psychol.*, 4, 1905, 288-436; A.

estimation of these studies, as well as of the papers which appeared during the long controversy that followed, must take two major circumstances into consideration. First, it must be remembered that these men were representatives of that great group of analytical psychologists who dominated experimental psychology throughout its early decades. Their primary task was the discovery and description of the 'elements' of mind. It should not surprise us, then, that Würzburg announced the discovery of 'thought elements,' *e.g.* the *Bewusstseinslage* of Marbe and the *Bewusstheit* of Ach. They were *new* elements: they appeared to be unanalyzable and they had no counterpart among the sensations, images, and feelings hitherto assumed as the building blocks of mind. The second significant circumstance is that the long controversy which they stimulated had always the character of a discussion between members of the same party. The opposing sides did not differ on their fundamental approach to psychological problems. The studies from the Cornell Laboratory, under the direction of Titchener,[4] did not raise a quarrel with the general analytical point of view. Titchener's attack was not directed against the 'search for content' but against the way the search was conducted.

Although the controversy over the question of 'imageless thought' subsided with the shift in psychology away from the structural approach, these older workers must be conceded two major accomplishments. The first is the development of the concept of task (*Aufgabe*) and its influence on psychological performance. The second is that it is impossible to write an account of these more complicated psychological activities without the introduction of functional terms and points of view. Titchener's attempt to re-define the Würzburg problems indicates the limitations of the structuralistic approach.[5]

New points of view in this field came with the development of Behaviorism and the doctrine of Configuration or *Gestalt*. While the followers of Watson turned the fire of their attack against the search for mental content and made high claims for the introduction of objective (non-introspective) methods, the Berlin group was

---

Messer, Experimentell-psychologische Untersuchungen über das Denken, *ibid.*, 8, 1906, 1-224; and K. Bühler, Tatsache and Probleme zu einer Psychologie der Denkvorgänge, *ibid.*, 9, 1907, 297-365; 12, 1908, 1-123, 123-192. Investigations directly influenced by this group of studies are C. O. Taylor, Über das Verstehen von Worten und Sätzen, *Zsch. f. Psychol.*, 40, 1905, 225-251; T. V. Moore, The process of abstraction, *Univ. Calif. Publ. Psychol.*, 1, 1910, 73-197, Image in meaning, in memory and perception, *Psychol. Monog.*, 27, 1919, (no. 119), 69-296. Cf. E. B. Titchener, *Lectures on the Experimental Psychology of the Thought Processes*, 1911, for an estimation of the Würzburg School from the point of view of the structuralist.

[4] T. Okabe, Experimental study of belief, this JOURNAL, 21, 1910, 563-596; H. Kakise, A preliminary experimental study of the conscious concomitants of understanding, *ibid.*, 22, 1911, 14-64; H. M. Clark, Conscious attitudes, *ibid.*, 22, 1911, 214-249, and E. Jacobson, On meaning and understanding, *ibid.*, 22, 1911, 553-577. Titchener maintained that, under the attitude of the search for quality (acording to Titchener, the 'descriptive' attitude, as opposed to the 'meaning' attitude), the 'imageless' contents of Ach and the others break down into sensory and imaginal contents of the familiar sort. Out of the controversy developed Titchener's context theory of meaning, which stimulated later research. Cf. H. P. Weld, Meaning and process as distinguished by the reaction method, *Titchener Commemorative Volume*, 1917, 181-208, for type of problem raised.

[5] A perusal of Titchener's chapters on thought in the *Textbook of Psychology* (1911) and in the *Beginner's Psychology* (1915) will reveal the functional character of the treatment. Such terms as task, determination, pattern, course, and goal are far from being structural concepts.

concerned with demolishing the doctrine of elements, especially the concept of sensation.

Behaviorists approached the problem of the more complicated psychological activities from those fields with which they were familiar, *i.e.* rote learning and animal behavior in maze and puzzle-box. For the first, the method of nonsense-syllables was at hand. No report save recital was required and the units of accomplishment were readily quantifiable, a great aid in making psychology appear 'objective.' In the second field, work upon the 'higher processes' readily degenerated into 'problem-solving' in the maze and other similar devices. The behaviorists were again satisfied with crude measures of accomplishment, typically written in terms of time, distance, and errors. Illustrative of behavioristic methods and results in the field of learning are investigations of 'concept formation' by Hull and Smoke.[6] We are here informed upon variations in output under a stated task (the experimenter's task), but are given little or no information on the character and the modifications of performance itself.

In the animal studies, too, the objective methods virtually omit, through lack of interest and training of the behaviorist and through a want of adaptability of the procedures, the entire group of problems which we here approach.

Animal studies also played their early part in shaping the methods and the interests of the adherents to *Gestaltheorie*. Köhler's investigation of chimpanzees in the solution of problems by an alleged 'insight' provides part of the setting for the configurational studies of thinking and understanding in man.[7] Wertheimer too urged that the 'association of processes' did not account for 'novel' learning.[8] Duncker formulated rules for problem-solving which follow organizational principles, as determined by the formal character of the problem.[9] Harrower's investigation of the understanding of jests represents a return to concepts developed by the adherents of *Gestalt* in their earlier studies of perceiving.[10]

Thus the analytic, behavioral, and configurational psychologies are chiefly responsible for the recent literature—experimental and doctrinal—upon the 'higher mental processes.'[11]

When we attempt to bring together the results under one common set of terms and rubrics, we are faced with serious difficulties. Külpe and Titchener speak of 'thought' and 'understanding,' the behaviorist affirms

---

[6] C. L. Hull, Quantitative aspects of the evolution of concepts, *Psychol. Monog.*, 28, 1920, (no. 123), 1-124; K. L. Smoke, An objective study of concept formation, *ibid.*, 42, 1932, (no. 191), 1-46.

[7] W. Köhler, *The Mentality of Apes*, 1925, 1-342.

[8] M. Wertheimer, *Über Schlussprozesse im produktiven Denken*, 1920.

[9] K. Duncker, A qualitative (experimental and theoretical) study of productive thinking, *Ped. Sem.*, 33, 1926, 642-708.

[10] M. R. Harrower, Organization in the higher mental processes, *Psychol. Forsch.*, 17, 1932, 56-120.

[11] Among the analytic group we reserve the term 'structural' to designate those psychologists whose dominant interest lies in the direction of an analytical description of mental existences. The structuralist is thus opposed to various forms of *functional* analysis. Cf. Madison Bentley, Historical derivation, in *Psychologies of 1925*, 1926, 383-393, who gives briefly an historical and critical account of 'psychologies called structural.'

that he is studying 'reasoning' and 'concept formation,' and the adherents of *Gestalt* write of 'productive thinking' and 'insightful behavior.' What do all these terms signify? Are all parties studying the same thing, or are they studying different things? It is difficult to find a satisfactory answer to these questions. Yet an answer of some sort is essential if we are to know exactly what these various researches have contributed to the knowledge of our group of psychological performances.

One of the basic difficulties appears to be that the experimental situations utilized by the various researchers differ widely in complexity. The analytical psychologist typically presents objects, words, or phrases to his observer, who is instructed to report under certain headings or categories. Within this framework of method, the experimental materials vary from simple drawings, as employed by Moore and others, to the complicated philosophical excerpts which Bühler used. Again, the behaviorist presents, simultaneously or successively, nonsense-words and nonsense-figures standing in certain relationships, requires no extensive report from his subject, but assumes that the task of concept-formation has been completed when his subject can indicate the absent member of a related pair. The configurationist requires his observer to solve relatively difficult problems, which depend for their solution upon the apprehension of subtle relationships between objects in their perceptive arena. Here again the difficulty lies not so much in the heterogeneity of the material as in the varying and uncontrolled demands made upon the psychological resources of the organism.

Where the experimental situations utilized by the various approaches to the 'higher' intellective procedures of the organism differ so widely, we may safely assume, in the absence of evidence to the contrary, that the performances of the subjects are likewise dissimilar. Certainly the reading of a word or the giving of a synonym appears to be quite a different sort of activity from the gradual development of the knowledge that *zak* always appears with triangular objects and *baf* bears some relation to circular figures. Even more widely does the solution of a mechanical puzzle appear to differ from these last-mentioned activities. In the face of these gross differences in experimental situations, it is plan that an attempt at establishing wide generalizations upon the basis of this mass of research would be a difficult, if not an unproductive, task.

In the absence, then, of a body of comparable materials and a set of comparable methods, the psychologist is left with few possibilities. He may extrapolate and interpolate from the available results in an effort to find what is common. This procedure is not promising because of diverse points of view and of treatment. Again, he may choose methods and results which

appeal to him, for one reason or another, and use them as a starting point for further research along the same lines. This choice is likely to rest upon preference. In the present confused state of the problem, not much is to be expected of it.

All these complicating things considered, it may be wisest to search out a new mode of attack.

Our general criticism of old procedures in this field—a criticism which carries with it our own proposal for research—is that too little attention has been paid to the relationship between the activities to be studied and the better known and more basic operations, upon which we have a great deal of authentic and well-attested information. Rather than the observation of the activities of an organism placed in some arbitrarily chosen situation, which we have just as arbitrarily called 'thinking' or 'understanding' or 'reasoning,' it would seem wiser at the outset to consider an observer in what is, at the beginning, a relatively simple perceptive and inspective situation, and observe minutely what happens as the organism gradually proceeds to somewhat more complex modes of activity.

Another criticism, supplementary to the first, is that the experimental situations dealt with by most of the researchers have been so complex and so variable that one is able to determine little more than gross outcome, *e.g.* that an answer was given, a concept 'learned,' or a problem solved. These men were dealing with activities undoubtedly more complicated and more variable than they could manage. What those activities were and how they stood related to one another we have no way of discovering either from the protocols or from the conclusions written down by the authors.

We propose, then, a study of these 'higher' psychological activities which will start with perceiving and move by small, controlled, and describable stages, in various directions toward greater complexity of operation. In order to define our task, we propose the following questions. How does the organism proceed from the prompt apprehension of a present object or occurrence to something which is indicated or 'symbolized' by it? We are accustomed to speak of an 'understanding' of symbols; but is it true that we are dealing here with a form of 'understanding,' or are we still near the level of perceiving? Is it possible to discover a number of hitherto undescribed types of performance between the perceiving of objects and the use of 'symbols'? Definitive answers to these questions would give us important information on the functional differences between many simpler and many more complicated varieties of performance.

Our experiments fall into two groups. In the first group (Part I) we attempt a general survey of all the varieties of performance which are

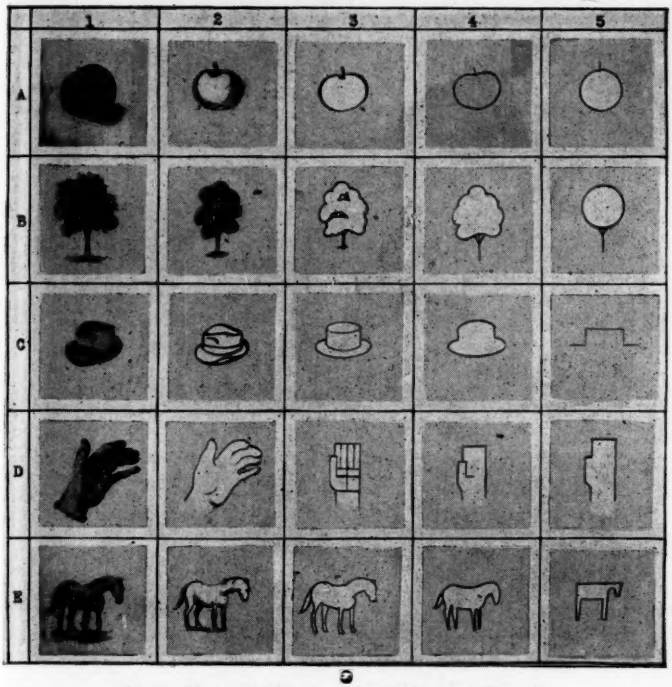



FIG. 1. DRAWINGS USED IN FIRST HALF OF PART I
(Reduced x 3)

aroused by the presentation of visual patterns differing in degree of concreteness and conventionalization. From the reports of our *O*s we have hoped to determine whether the apprehension of concrete objects is the same sort of performance as the apprehension of highly conventionalized and abstract patterns, or if, from the beginning, certain differences in performance are to be discovered. In the second group (Part II) we have devised experiments which would bring out more specifically differences in performance as revealed in our first group, with special emphasis upon the operations involved in dealing with symbolic materials.

## PART I. VARIETIES OF PERFORMANCE

*Series 1. Observations under relatively long exposure.* In this preliminary section of our investigation we sought a general survey of all the varieties

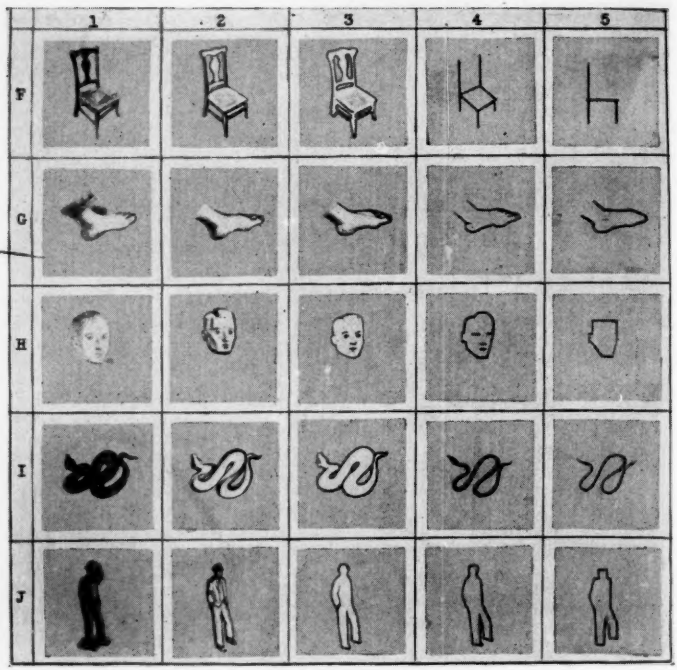



FIG. 2. DRAWINGS USED IN SECOND HALF OF PART I
(Reduced x 3)

of performance which are aroused by the visual presentation of patterns which differ in concreteness and conventionalization. We hoped to determine from reports how the organism proceeds from the perceiving of concrete objects to the apprehension of simplified, elliptical, and vestigial drawings of those same objects.

*Apparatus and setting.* We constructed a series of ten objects, drawn in five stages or degrees of conventionalization—from a fully detailed, concrete picturization to an abstract, highly schematic drawing (Figs. 1 and 2). These were presented in haphazard order to 5 *Os*, who served independently of each other and without specific knowledge of the problem and of the serial relations. The objects were approximately 2 in. in diam. and were exposed in a mirror tachistoscope, modified to permit a large exposure-field.[12] The time of exposure was governed by *O*,

[12] The *Os* were Miss M. B. Erb (*Er*), Mrs. T. A. Ryan (*Mr*), Miss M. L. Lemmon (*Le*), Mr. H. P. Dahms (*Da*), and Mr. T. A. Ryan (*Ry*), graduate students in psychology. The apparatus has been described by J. G. Jenkins, A simple tachistoscope of many uses, this JOURNAL, 45, 1933, 150. Professor Bentley made a point of running through each new series, as observer, before it was formally thrown into use.

who signaled when he was prepared for the exposition to begin or end. The instructions were as follows.

Fixate the small black dot. When you are prepared to observe say 'Ready!' *E* will answer 'Now' and present materials for observation. Observe until you are satisfied, then say 'End!' Report into dictaphone. Begin by naming object, then give the course of performance, noting the modes utilized, their products, and governmental factors. Finish report by saying 'End.'

*Results.* Since our patterns vary widely in detail, it is not to be expected that the activities utilized in dealing with them will be uniformly of the same kind and variety. The general run of activity appears to be the typical perceiving of objects with which we are familar from other contexts. But within this broad performance we have been able to distinguish several modes and varieties, not rigidly distinct but gradually shading one into another. Four of these varieties can be distinguished and exemplified from our protocols.[13]

*(a) The figurational variety.* Here the visual pattern is apprehended as an unknown 'figure,' with no or little resemblance to any known object. The most common occurrence of this mode of performance was with presentation of the most highly schematic patterns (Fig. 1, column *5*). Here are reports.

*Er:* (1) Perceived (rectangular outline figure). (2) Inspection under self-instruction (find out what kind of object it was, and whether anything beyond a geometrical figure). (D5)[14]
*Ry:* (1) Only perceiving (geometrical form). (2) Irregularities of line led to inspection which resulted in comment ("it is not a typical geometrical form"). (D5)
*Mr:* (1) Perceived (lines forming an L in center of figure). (2) Tried to find object: unsuccessful. (G5)
*Da:* (1) Perceived (ambiguous figure with certain familiar features: figure broke down into lines). (B5)

The inadaquacy of the first perceiving, upon presentation, sets a task which *O* tries to resolve by scrutiny and inspection.

*O* usually succeeds in giving some sort of name to the figure, but the product is characterized by extreme lability and unstableness.

*Ry:* (1) Geometrical figure. (2) Inspection (to discover what it represented). First product (a smoke-stack or a steamer with a little steamboat whistle fastened to the side); (3) possible but not satisfactory. (4) SI (to remember ground-plans of various buildings); irregularity on side made that impossible. (5) Recurred to a smoke-stack several times. (D5)

---

[13] The names to these four modes of performance were taken from A. S. Rogers, An analytical study of visual perception, this JOURNAL, 28, 1917, 548 ff. Rogers reports results comparable to ours, although they were obtained in a quite different experimental context.

[14] Symbol at the end of each report signifies stimulus-pattern presented (cf. Figs. 1 and 2). Within the functional report, numbers refer to functional sequence; the functional modes are non-parenthetical; and the functional products are within parentheses.

*Da:* (1) No name . . . (2) remembered (previous figure described as pile with projecting piece . . . ) this differed in a number of details; (3) remembered (figure described as smoke-stack), but present object had even less in common . . . (4) Self instruction (to find what present object is): product, (rather odd furnace with door). (H5)

*Le:* (1) Ambiguous figure. Perception (lines; no particular object); (2) inspection and comment ("lines are part of top of castle wall"). Continued inspection (cross-section of railroad station bench then carpenter's drill . . .). (C5)

The whole performance initiated by the figurational mode is characterized by uncertainty and a great deal of casting-about. There is usually a definite task to recall previously presented patterns and a good deal of inspection of remembered objects. Stabilization rarely, if ever, is reached.

*(b) The generalized variety.* The visual pattern is apprehended as a generalized member of a class, rather than as a particular, concrete object. This mode occurred especially with those patterns that were neither too detailed nor too abstract. Here are a few examples.

*Er:* (1) Perceived (man), (2) inspection brought particularization as (young man, either tramp or college boy). (J2)

*Ry:* (1) Perceived (face), (2) Inspection (qualification that features are simply straight lines, all alike). (H4)

*Mr:* (1) Perception (animal), (2) later product 'horse' came). (E4)

*Da:* (1) Perception (horse), (2) later perceived (typical broken down dray-horse). (E2)

From these protocols it is obvious that the apprehension of a figure simply as a member of a class sets a task to particularize. If the figure presented is one of the less detailed patterns, *O*'s search is usually unrewarded; but if the figure is more detailed, *O* begins to qualify his originally non-individualized apprehension. Thus, after an originally generalized apprehension, we find our *O*s adding such comments as 'fat snake' (*Er,* I2), or 'football player' (*Ry,* J2) or even 'toy horse' (*Ry,* E2). In most cases, however, the pattern appears to resist particularization and the later comments serve merely to substitute another general class for the original one.

*(c) The abstractive variety.* In this mode of performance the figure is apprehended as an abstract or conventionalized representation of a well-known object. The reference here is not to a class or group of objects but to a particular object. The figure is taken as a simplified or conventionalized drawing of *this* face, or *that* horse. This type of operation occurs most frequently when a less detailed drawing of some object is presented after a more detailed drawing of the same object. A few reports will be representative.

*Er:* (1) Perceived (outline drawing), naming ("apple"). (2) Inspection with product ("pumpkin"). Self-instruction (to compare this figure with one given previously). (A4)

*Ry:* (1) Perception (conventional outline of man), comment ("came as before but he has his hat off"); (2) inspected memory of figures of man seen before. (J4)

*Mr:* (1) Apprehended (man). (2) Noticed it was conventional and all lines

were straight . . . (shape of chin reminded me somewhat of Neff). (H4)
*Da:* (1) Perception (crude outline of chair), name immediately. (2) Noticed that this chair was in profile while other chairs had faced me. . . . (F5)
*Le:* (1) Perception (outline of man's figure, in same position as the picture of man seen previously), (2) Comment ("that man again . . . "). (J5)

This abstractive mode of performance, comparable to the figurational variety, is characterized by a certain degree of lability and instability. *O* tends to remain dissatisfied with his initial apprehension and designation and casts about for a more adequate (for him) signification. Typically, however, his report ends with a return to the original apprehension.

*(d) The depictive variety.* In this mode of performance the visual pattern is simply apprehended as this or that concrete, particular object. As is to be expected, this mode was aroused in special degree by the most detailed and realistic drawing of each set or, in some cases, by less detailed drawings which appeared quite late in the series when a certain degree of stabilization had already taken place (see below for discussion of changes in course of series). The performance here runs its course in a matter-of-fact way. Very often *O* departs from the stimulus-situation entirely after the first moment or two of apprehending, and enjoys a memorial or imaginational tour among similar objects. Examples follow.

*Er:* (1) Perception (foot): immediate verbal naming; (2) query ("why a bare foot?"); (3) memory (Erskine Caldwell's stories, then play *Tobacco Road*); (4) query ("why these things?") comment, (I must have taken it as a negro's; (5) query "why?" (answer: it is barefooted . . .); (6) enlargement of barefooted topic with many details. . . . (G1)
*Ry:* (1) First perceiving (apple); (2) noted (characteristic stripes); (3) query ("is it a Northern Spy?"); (4) remembered (seeing these apples in front of a grocery store yesterday, and also Northern Spy tree at home in yard . . . ). (A1)
*Mr:* (1) Perception (horse) with comment ("more realistic"); (2) curve at back of horse suggested Father's horse (visual memory of Father's horse); (3) inspection (not a saddlehorse but a work-horse . . . ). (E1)

The description of these four ways of apprehending line-patterns—figurational, depictive, generalized, and abstractive—gives some indication that the generic term 'perceiving' refers not to a single kind of performance but to a number of differing activities. That perceiving is multiple rather than single should not surprise those who have devoted themselves to a study of perceptive operations. At the same time, current experimental studies of the general character of perceiving differ somewhat from ours in approach, method, and treatment; therefore an analysis should be made before we compare our results with others.

Most studies made in the field have been concerned with tracing the course of development of perceiving and with defining various 'stages' in that course. Baade[15] presented nonsense-figures and interrupted *O*'s perception at various intervals with

[15] W. Baade, Experimentelle Untersuchungen zur darstellenden Psychologie des Wahrnehmungsprozesses, *Zsch. f. Psychol.*, 79, 1918, 97-127.

requests for 'introspective reports.' He notes the presence of four stages or phases, from the bare apprehension of *Etwas* to the expression of a formal statement about the object. The first stage is that merely of 'sensation plus apperception,' the apprehension of the figure and the reproduction of associative material. Next we find the *vorsprachliche Phase,* which is fractionated into two subdivisions; the stage of *Noch-nichterkennen* and that of *unsprachliche Erkennen.* Finally, there is the pronounced judgment, which terminates the entire act of perceiving. Moore, also working with nonsense material, finds the following stages.[16] First, there is simply "the idea of some kind of figure;" second, there is a "more or less specialized idea of the figure;" third, there is a "correct idea of the figure . . . but doubt or error as to its orientation;" fourth, there is a "correct idea of the figure . . . with a true knowledge of its orientation." Rogers employed stimulus-patterns of various degrees of meaning and observed the changes in perceiving which occur with repetition of the stimuli.[17] Although she notes no distinct stages or phases, she does report modification in the total pattern of the perception, largely in the accessory kinesthetic, organic and imaginal processes. There was no correlation reported between the richness of the object and the arrangement of these accessory processes. Dickinson presented letters and playing-cards to his *O*s for very brief intervals and asked for 'introspective reports.'[18] He names "three main levels, not separate and distinct, but in the nature of a progression. . . . We designate these levels: visual pattern, generic object, and specific object." Freeman utilized inkblot figures of varying degrees of significance, suggesting to his *O*s that the blots can be taken to represent a familiar object.[19] The initial stages of apprehension yielded merely the general extent and 'thereness' of the stimulus-pattern; later perception of some 'thing' took form; finally, the stimulus-pattern assumed definite object character. It was assumed that the perception had run its course when a name could be attached to the object. Drury projected line-patterns on the peripheral parts of the retina and studied the changes which occur on repeated perceiving.[20] As opposed to most other investigators, she finds no evidence for a well-defined series of stages in development but rather she notes a general change from an initially unstable and uncertain apprehension to "a fixed, stable and conclusive performance whose end-product was a determined and abiding object." Stewart presented stimulus-ojects to four sense-departments, visual, auditory, olfactory and tactual, and requested reports from her *O*s as perceiving was repeated.[21] Unlike some of her predecessors, Stewart finds that "from the moment of initial stimulation until the final point of apprehension is attained, something is apprehended as an object." Five levels of performance may be distinguished. First, there is a brief stage of *examination,* whose product is a mere enumeration of features; this initial phase is succeeded by a stage of *generalization,* where the

[16] T. V. Moore, The process of abstraction, *Univ. Calif. Publ. Psychol.,* 1, 1910-16, 73-197.

[17] A. S. Rogers, An analytical study of visual perception, this JOURNAL, 28, 1917, 519-577.

[18] C. A. Dickinson, Experience and visual perception, *ibid.,* 37, 1926, 330-344.

[19] G. L. Freeman, An experimental study of the perception of objects, *J. Exper. Psychol.,* 12, 1929, 341-358.

[20] M. B. Drury, Progressive changes in non-foveal perception of line-patterns, this JOURNAL, 45, 1933, 628-646.

[21] C. A. Stewart, *Sequential Changes in the Perception of Objects,* Doctoral Dissertation, Cornell University, 1933.

object is referred to a class; thirdly, comes a stage of *specification,* in which the object is particularized; fourthly, there is a stage of *familiarization,* or further acquaintance with an already known object; and finally, a stage of *stabilization,* in which nothing more is reported about the object.

As may be seen, our four modes of apprehension—the figurational, depictive, generalized and abstractive varieties of performance—find their counterpart, to some extent, in various of the 'stages' and 'levels' reported, under a variety of experimental conditions, by these investigators. It is not our intention to raise the question as to whether these researchers were really defining stages in the course of development of perceiving, or whether they were dealing with distinct performances, which make their appearance in a progressive fashion simply because of the character of the experiments. We wish, however, to emphasize the point that the kinds of activity which have been assumed to constitute sequential changes in the development of a single performance make their appearance in isolation in our experimental situation. However we wish to interpret these results, the conclusion seems warranted that the general performance called perceiving exhibits a variety of subsidiary types or modes, which may appear either in sequence or in isolation, depending upon the character of the experimental setting.

The discovery of differing modes of apprehension assumes fundamental importance in the light of the problem set by this paper. We have said earlier that we proposed to approach our investigation of the more involved psychological performances from the side of perceiving. Only in this way, we argued, can we obtain information upon the transitional forms of activity which may possibly lie between the sort of thing which is obviously perceptive in character and those operations which all agree are 'higher,' more complicated, and, it is probable, later in point of development. The writer believes that certain of these modes of apprehension described above constitute such transitional forms between mere apprehending and more involved operations.

If we scrutinize the characteristics of the four kinds of performance thus far defind by our experiments, we find that their fundamental differentia is in terms of the relationship in which *O* stands to the perceived object. In the *figurational* variety, *O* is, so to say, limited to the object. He is working under a formal instruction to name all figures which appear and, in those cases where the stimulus-pattern seems to resist such naming, *O* spends his observational time in search and scrutiny of the formal details of the figure. When *O* is observing in a *depictive* manner, his relation to the figure is as direct as in the previous case. The object is taken quite simply as 'that horse' or 'that apple' with no reference beyond the figure in

any direction. The task is, of course, satisfied with the first moment of perceiving and, if *O* is at liberty to do so, he then proceeds to other things. In the abstractive and generalized forms, however, the reference is beyond the figure presented to something quite different. In the *abstractive* mode the figure is taken as representative of some other object, as a conventionalized drawing of this or that well-known thing. The figure here does not stand by itself but points in a certain direction; it is taken as a surrogate, rather than as an object complete in itself. The sort of activity we have called *generalized* also refers beyond the presented figure, but now not to a particular object but to some class of things of which the apprehended object is a member. The reference now is to a group; not to 'this chair' but to 'chairs.'

It is these two last described activities—the abstractive and generalized—which we take to represent transitional forms between the ordinary perceiving of objects and those more elaborate operations which we know imperfectly under the terms 'understanding' and 'thinking.' When engaged in performing in these latter ways the human organism is already passing beyond a mere survey of objects and events. The object is not taken simply *qua* object, but now serves to point beyond itself; it is taken as a representative of something which it is not. We approach here the sorts of performance involved in reading words and sentences, in formulating and developing topics, or in solving problems by symbolic means. In the case of these further developed activities, the organism is operating with a considerable independence of stimulus and the perceptive product. But in the modes of apprehension that we have discussed here in some detail, this independence of the object is already beginning to become manifest. In the abstractive and generalized modes of apprehension we can detect characteristics which become much more striking in understanding and thinking and which also supply materials for these operations.

*Changes in course.* Thus far in our discussion we have lifted out of context and described in isolation what we consider to be the most important result of this first series. In describing and analyzing the four ways of performing which *O*s exhibited, we have made no attempt to take account of the total matrix of activity in which these four were imbedded. To complete our account we must now describe the operations of our *O*s as a whole, during the presentation of the entire series.

During the course of presentation of the whole series, certain changes occurred in the performance of all *O*s. These may be summarized as follows.

*(a) Changes in the nature of the occasion.* Whereas at the beginning of the series *O* tended to take each pattern by itself, making no effort to

relate or compare it to others, the occasion gradually widened to include all previous patterns as well as the present figure. Near the beginning, usually with the first appearance of a member of a group from which some item had previously been encountered, this widening of the occasion consists simply in a relating of the present figure to a previous similar figure. Resemblances and differences are noted, and little more. Here are examples of this initial change.

*Er:* (1) Perception (horse), with comment (same as previous presentation); (2) inspection brings comment (more lifelike than previous horse). (E2)
*Ry:* (1) Perception (outline figure); (2) self-instruction (memorially to inspect previous apple); (3) query ("is this the same?"), no stable product. (4A)
*Mr:* (1) Perceived as (similar to the figure seen yesterday); (2) inspection (extra lines forming an L in the center of the figure). (D4)
*Da:* (1) Perception (apple); (2) remembered (similar to figures previously shown); (3) inspection to find differences (added details and changes in shading, shape and stem . . . ). (A3)
*Le:* (1) Perception (recognition, accompanied by kinesthesis of saying to myself "I've seen this before"); (2) inspection (lines at side heavier . . . also a circle around stem is different from previous figure . . . ). (A3)

As more and more figures of the same group are presented, the series begins to break up into a number of sharply separated groups. Whereas at first there were, from time to time, attempts to compare a figure of one group with some figure of another group, as the experiment proceeds these attempts to establish relationships between groups are no longer apparent. Rather does each new presentation appear as 'another member of that group' or as 'horse again.' *O* quickly become convinced that the series contains a number of subdivisions, to one or another of which the new figure 'belongs.' Illustrative of this sort of change are the following protocols.

*Er:* (1) Perception (hat) with verbal naming; (2) 'flash' ("oh yes, this is another of the hat series . . . "). (C1)
*Ry:* (1) Perception (horse) with comment ("that horse again"); (2) further comment ("this horse is half-way between the two I've seen . . . "). (E3)
*Mr:* (1) Perception (horse) comment ("this belongs to the same horses I've seen before . . . "). (E1)
*Da:* (1) Perception (familiar snake) name coming immediately . . . ; (2) self-instruction (to compare with previous figures) product (present figure has same general shape as previous ones . . . ). (I2)
*Le:* (1) Perception (chair) comment ("this is the same one I've seen before, is the photograph from which others were probably drawn . . . "). (F1)

*(b) Changes in task.* The changes in the occasion, discussed and exemplified above, brought about corresponding transformations in the task under which *O* worked. At the beginning, when *O* was simply apprehending isolated figures, with no relationships yet apparent to link them, the task was essentially that implied by the formal instructions. *O* understood that his primary task was to name and, secondarily, to describe the course of performance during exposure. We find that *O*'s behavior under this first

task was directed in general toward a scrutiny of perceived details of the figure in order to determine whether the name given was appropriate. For example:

*Er:* (1) Perception (merely of man); (2) inspection (it was a young man, either tramp or college boy); (3) final comment ("if the shoes were different it would be a tramp, but the shoes are those of a college boy"). (J2)
*Ry:* (1) Perception (horse), followed immediately by doubt; most horse-like feature curve of back, but legs too straight and out of proportion. (2) Perceived (sheep, but still somewhat horse-like . . .). (E4)
*Mr:* (1) Perceived (line pattern); (2) inspected (to find an object); (3) (a handle for something, but then decided it wasn't). (4) Perception of one side (end of an arrow but . . . whole thing couldn't be like an arrow). (5) Instructed myself again to look for an object, but couldn't find any. (D5)
*Da:* (1) Perception (as horse); (2) inspection of details revealed (several unhorselike features . . . might be wooden toy horse); (3) later product of inspection ('zebra'). . . . (E4)
*Le:* (1) Perception (hand up-raised); (2) inspection revealed (what was thumb of hand was a small chair with rest of drawing as back-ground); (3) repeated inspection (figure might be fan). . . . (D4)

With the first change in the occasion—the inclusion in the situation of a previously present figure—came a change in the nature of the task. Naming now was incidental and an inspective comparison of the details of the two drawings became the primary task.

*Er:* (1) Perception and with it naming of apple; (2) self-instruction followed (task to compare with last apple seen); (3) inspection (to determine whether this also could be a pumpkin). (A3)
*Ry:* (1) Perception (outline of apple); (2) tried to inspect memory of previous apple to see whether this was outline drawing of same one. . . . (A4)
*Mr:* (1) Perception (tree; word immediately); (2) then recognized (tree seen yesterday, but it had leaves on and a great deal more detail). (3) Self-instruction (to find man seen yesterday). (B1)
*Da:* (1) Perceived (apple) then (2) remembered (that it was similar to figure previously shown). (3) Inspected (to find differences): (added details, shading, stem and shape made figure more appropriately an apple). (A3)
*Le:* (1) Perception (snake), followed by (2) comment (this is like the other snake only not so large). (3) Inspection (reveals shape of snake is similar to one seen previously . . . head now arrow-shape). (I4)

With the first change in the occasion, then, the task shifts from that of naming to that of comparing. This comparing, however, is not yet directed toward any particular goal; *O* is scrutinizing the perceptive details of two figures for want of anything else to do. With the second change in the occasion, however,—*i.e.* the splitting up of the series into distinct groupings—the comparing of figures took on direction and purpose. *O* very soon sought to discover the plan of presentation and the nature of the relationships between various members of the presented material. Both naming and superficial comparison of detail then became subsidiary to the now central task of comprehending the plan of presentation. Each figure now served merely to develop or reject a projected hypothesis as to the nature of this plan.

*Er:* (1) Perception (horse), with (2) comment (same as previous observation). (3) 'Flash:' (this figure and previous figure seem to build up the picture of a general subject or topic 'horse'—"evolution of horse?"). (E2)

*Ry:* (1) Perception (outline of previous foot). [For some time I have been assuming that these figures are being presented in an order from outline to a fully shaded figure, but now came] (2) task ("what is plan of presentation?"). (3) Memorial inspection of previous presentations with result (order is from outline to fully shaded and then to conventional again); [this not satisfactory since some cases didn't fit]. (G4)

*(c) Changes in total performance.* As the experiment proceeded, *O* began to develop a scheme or outline of the plan of presentation and the nature of the experimental materials. This development of a comprehension of complicated inter-relationships, presumed to exist between the various members of the series, paralleled the changes which occurred in occasion and task. Out of this elaborate process of comprehension came various sets and expectations which inclined *O* now to this, now to that, type of apprehension. This *orienting comprehension,* then, began to set the stage for subsequent perceiving.

With some *O*s this process of comprehension of the plan of presentation and the nature of the stimulus-patterns proceeded to such a well-stabilized and developed form that figures came to be apprehended as "the third in the series of apples" or "the fifth in the series of horses." In these cases, the number applied to the figure does not simply refer to the fact that three or five figures of the same object have appeared before, but rather to the degree of conventionalization or concreteness. The figure is fitted into its place in a scheme developed by *O,* a scheme which calls for five patterns, differing in certain well-defined ways in richness of detail and degree of abstractness of form. Some examples will serve to make this distinction clear.

*Er:* (1) Perception (man, verbally named). (2) Inspected perceived and remembered men . . . product (this is the first in the series). (J4). (1) Perception (man) (2) placed this figure as first, displacing a former figure. . . . (J5)

*Ry:* (1) Perception (horse); (2) comment ("this horse is halfway between the two I've seen"). (E3)

*Mr:* (1) Perception (horse); (2) comment ("this belongs to the same horses I have seen before, but this is most realistic"). (E1)

In the development of this important mode which we have called *orienting comprehension*—'orienting' because its function appears to be to prepare the observer for later apprehension—we pass beyond apprehensive operations to a performance which can, justifiably, be described as 'higher' and more involved. Our endeavor to approach the more complicated activities of the human individual from the side of simple perceptive operations has been realized. For it is this sort of performance which we believe constitutes a further step in the scale of psychological performance, from per-

ceiving onward. This *orienting* mode shows a significant similarity to the 'insightful behavior' made so much of in configurational research (cf. Köhler, Wertheimer, and others, above). Like 'insight' the exercise of this mode of performance serves to contribute an understanding of certain necessary relationships between perceptive materials; an understanding which becomes useful in guiding and controlling the course of later perceiving. Under the conditions of our experiment, however, this mode of performance does not make the sudden and unanticipated appearance which is assumed to be the central characteristic of 'insightful behavior.' On the contrary, *orienting comprehension* appears, in most cases, to exhibit a definite temporal course; it seems to develop rather than spring full-grown into view. During the course of this development, successive figures appear as test-cases, used by *O* to support or weaken a projected hypothesis as to the nature of the presented materials. In some of our *O*s (*Ry, Mr*) the process never became completely stabilized; in one (*Da*) it was scarcely apparent.

*Series 2. Observations under brief exposure.* This series was introduced to make more concrete some of the results of Series 1. In the first place, it was devised to yield more precise information upon the initial stage of performance at each exposition. Again, we wished to determine what effect repetition of the figures would have upon the developed performance with which *O* concluded the first series.

The same experimental materials were utilized, three important modifications being introduced in procedure. (1) The time of exposure was reduced to a fixed interval of 80 ms., as controlled by a condenser-charge timer.[22] (2) *O*s were instructed to report into the dictaphone as soon as the exposure was completed. This caution was introduced to end a performance which might run on after exposure. (3) The haphazard arrangement of the drawings used in Series 1 was retained with the exception that the order of presentation was reversed, the first drawing of Series 1 being the last drawing presented in the present series. It was hoped that the first two modifications in procedure would tend to shift *O*'s emphasis toward the initial part of the performance. The third modification might yield significant information on any variables introduced by the position of a pattern in the series. The formal instruction read as follows: At "ready," fixate the small black dot. At "now" observe the figure which appears briefly. Report *at once* into dictaphone, fully characterizing your performance.

*Results.* The results of Series 2 indicate quite conclusively that the modifications and changes in performance which ran their course in the former series had, by the end of the series, attained a very high degree of stabili-

[22] The timer was modelled after that described by J. G. Jenkins and W. D. Moeder, A condenser-charge timer, this JOURNAL, 45, 1933, 742-744.

zation. Those *Os,* particularly *Er* and *Ry,* who had elaborated a comprehension of the plan of presentation of the earlier series tend to apprehend the figures of the new series in terms of the general scheme which they had developed. At the very beginning of this new series, we find such reports as the following.

*Er:* (1) Immediate perception of object . . . (2) 'flash' (I have seen this before, it was one of the series of hat . . .) (C5); object apprehended (as first man in series) (J5); object perceived (detailed figure of man, and as final one in series). (J1)

*Ry:* Same outline of man I had before; (1) perceived at once (as familiar); (2) memorial running through of several of the objects of the previous series. (J5)

On the other hand, those *Os* who had not developed a general scheme of the first series did not succeed in doing so as the figures were now repeated. For these *Os,* the figures were certainly apprehended as familiar and there were constant references back to the preceding series, but no attempt was made to place a presented figure in its proper position within the group. The initial performance which typically occurs on presentation of a figure to these *Os* is a more or less simple identification, accompanied by a memorial reference to the previous series:

*Mr:* (1) Perceived first (simple lines), then (2) perceived as hat . . . (3) comment ("it belongs to a class I've seen in the other series"). (C5). (1) Immediately recognized (foot, belonging to a class of objects that I've seen before). (G2)

*Da:* (1) Perception (familiar outline figure of man), with perception came (2) verbal comment ("same as one previously shown"). (J5). (1) Perception of foot . . . with (2) comment ("this has been shown before"). (G2)

*Le:* (1) Outline of man's face seen in other series . . . (H3); (2) Perception (outline of snake), accompanied by recognition that I have already seen this object before . . . (I3).

No important changes in either task or occasion occurred during this series.

*Summary of Part I.* The problem of this first part of our study was to discover how the performances of *O* change as he proceeds from the perceiving of concrete objects to the apprehension of extremely schematic, elliptical and conventionalized drawings of these same objects. We hoped in this manner to discover hitherto undescribed transitional modes of performance between simple perceptive apprehension and the more complicated activities of understanding and thinking.

Our results indicate the existence, under the conditions of our experiments, of at least four differing modes of perceptive apprehension. Following Rogers (cf. footnote 13 above), we have termed these modes the *figurational, depictive, abstractive* and *generalized* modes of apprehension. We have agreed that the first two—the apprehension of a figure as 'just a line pattern,' and its apprehension as a 'concrete, particular object'—

resemble, and are probably identical with, the typical perceiving of objects involved in most descriptive experiments on perceiving. On the other hand, we have argued that in the abstractive and generalized varieties of performance—the taking of a figure as a 'generalized member of a class' and its apprehension of an 'abstract or conventionalized representation' of some well-known object—the organism is already beginning to pass beyond the object in certain well-defined directions. It is in these ways of 'passing beyond the object' that first departures from ordinary perceptive apprehension occur, and that the beginnings of more complex performances appeared.

In addition, the results of Part I have enabled us to describe a kind of operation which we have called *orienting comprehension.* This mode of performance apparently develops with certain well-defined changes in occasion and task, and it serves to set the stage for subsequent changes. Upon repeating the presentations of the stimulus-patterns, it was found that the schemes and references within figures, as developed by *O* in the first series, were now stabilized sufficiently to persist without change.

## Part II. Approach to Symbolic Comprehension

We have, then, obtained results which point towards the existence of a number of modes of perceptive apprehension, two of which constitute transitional forms between ordinary perceiving and more developed performances. Thus far we have made no systematic attempt either to investigate the conditions of appearance of these transitional kinds of activity or to examine their functional characteristics. To these tasks we now turn. Especially shall we watch for those transitional forms which promise to be 'symbolical,' either in process or in product. Certain discoveries from the preceding experiments very strongly imply that the transition from perceiving to comprehending introduces those objects commonly called symbols which play a primary rôle in elaborative thinking.

The common notion of symbols and symbolizing from which we must set out upon our experimental quest looks upon the symbol as standing-for, implying, pointing-toward, something which is not itself. In the series just reviewed this kind of 'reference-beyond' was not very frequent. To be sure, many of the objects perceived did lead on (usually by a memorial reference) to other objects in the set. But this sort of 'leading-on' is the kind implied by the 'laws' of contiguity and similarity, where an object apprehended is followed by a contiguous or a similar object. There is no symbolizing here, however; the first object does not point-to or signify another. This 'associative' ordering, which we have amply noted, is precisely the same as the

flow of the perceptive train when the eye sweeps the pictures in a gallery or the objects on the landscape. Now we seek quite another kind of reference, a reference which is sometimes an event (as when humpy soil comes to imply that earthworms have been sending up their casts) and sometimes not, as when the symbolizing object is nothing but a 'sign,' hiding its own independent existence.

Here our experimental essay seeks factual materials upon this important matter of symbolizing.

*Apparatus and materials.* The stimulus-objects were a series of 100 drawings, 4 each of 25 arbitrarily selected objects. Every set of 4 consisted of the following. The first was detailed and realistic; the second was a generalized drawing which presented the same class of objects, but no particular member of that class; the third was a highly conventionalized, abstract drawing, comparable to stage 5 of Series 2 (cf. Figs. 1 and 2); and the fourth was a 'symbolic' drawing, often of the cartoon type. For example, the 'house' series (Fig. 3, no. 7) consists of (1) a realistic drawing of a cottage, (2) an unshaded line-drawing of the front elevation of a house, with a rectangle for door, (3) an open isosceles triangle, resting upon a square, and (4) a detailed drawing of a door-mat, with the word *welcome* prominently displayed upon it. In guiding the artist employed to execute the designs, special care was taken that the 'symbolic' figures (those marked *d* in Fig. 3) should not all stand in the same relationship to the first three of the set. In some cases the fourth drawing represented a part of the object depicted by the first three (Figs. 3 and 4, 5*d*, 19*d*), whereas in others the relationship is less direct.

These figures were presented in the mirror tachistoscope utilized in Part I. The time of exposure was limited to 100 ms. in Series 1 and 2, and to 2 sec. in Series 3 and 4.

*Series 1 and 2. Conditions of the apprehensional modes.* The experimental arrangements are now designed to encourage—among other modes of performance—the sort of symbolical reference which we have described.

In Series 1, 100 patterns (Figs. 3, 4) were arranged for presentation in such a manner that 12 sets of four (48) were used in order from the most realistic in each set to the most 'symbolical' drawing, and the other 13 sets (52) in exactly the opposite direction; both these sub-series were so interfused that no two drawings of the same object immediately followed each other. This arrangement served two purposes; (1) *O* could thus apprehend the figures individually in an isolated manner (leaving relationships between members of a set until a later series); and (2) the arrangement brought out the effect of presentation of a detailed figure upon subsequent apprehension of a conventionalized drawing of the same object. Formal instructions for Series 1 follow:

At 'ready' fixate the small black dot. At 'now' observe the figure which appears briefly. Report into dictaphone. Make your report in two distinct sections. (1) First give course of performance, indicating functional modes and the forms of instruction. (2) Then indicate the product of your performance according to the following suggested descriptions (or according to any other that seems to you to fit): (a) just a line drawing—no name; (b) concrete, particular object; (c) not a particular

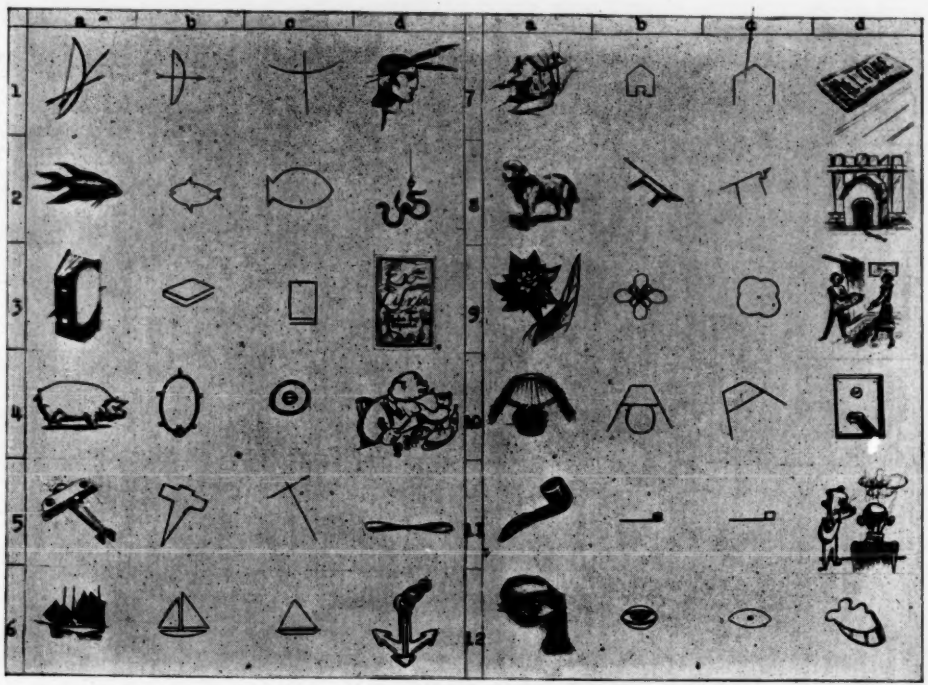



FIG. 3. DRAWINGS USED IN PART II

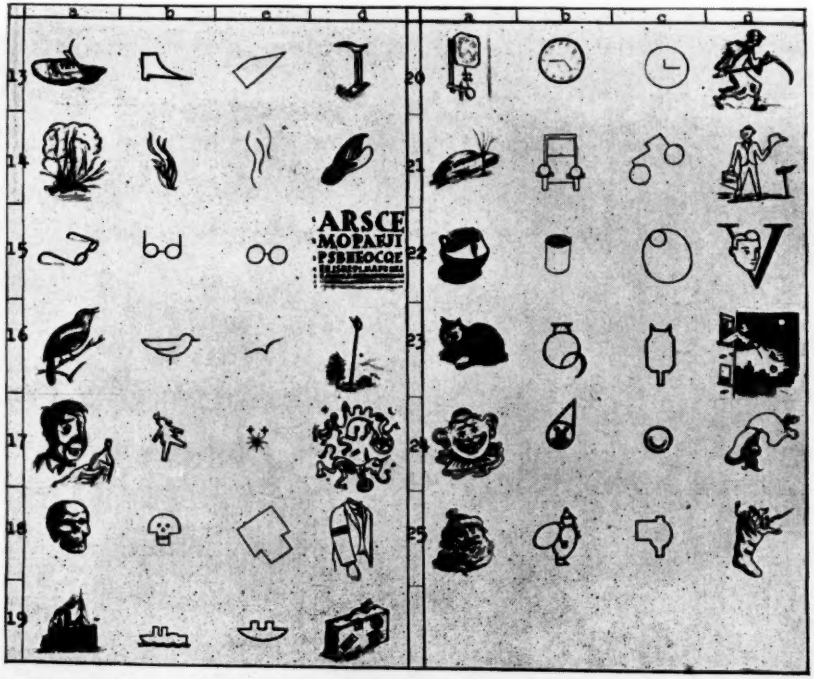



FIG. 4. DRAWINGS USED IN PART II

object—generalized member of a class; (d) something which stands for, or suggests, something else; (e) conventionalized drawing; and (f) any other.

*Caution.* It is not a part of your task to name, identify, or relate product to other products. Simply take each occasion as it comes.

In Series 2 only one important change was introduced. Instead of an apparently haphazard order of presentation, the members of each set now appeared in direct succession. Within each set, however, the order of appearance of the various members is haphazard. In Series 2, then, the members of each group are brought together, but appear in no fixed order. *E*'s instructions take the following form:

TABLE I

SERIES 1. FIVE KINDS OF FUNCTIONAL PRODUCT: WITHOUT CONTEXT
(PERCENTAGES OF 25 REPORTS: CF. FIGS. 3, 4)

| Drawing | *O* | *jld* | *cpo* | *gmc* | *sse* | *cd* |
|---|---|---|---|---|---|---|
| | *Er* | | 68 | 28 | 4 | |
| | *Ry* | | 84 | 16 | | |
| *a* | *Mr* | 4 | 72 | 24 | | |
| | *Da* | | | 96 | 4 | |
| | *Le* | | 100 | | | |
| | Totals | 4 | 324 | 164 | 8 | |
| | *Er* | 4 | 12 | 72 | 4 | 8 |
| | *Ry* | 12 | 4 | 8 | 24 | 52 |
| *b* | *Mr* | 4 | 32 | 16 | 20 | 28 |
| | *Da* | 8 | | 52 | 36 | 4 |
| | *Le* | | 28 | 8 | 16 | 48 |
| | Totals | 28 | 76 | 156 | 100 | 140 |
| | *Er* | 56 | | 36 | 8 | |
| | *Ry* | 36 | | | 36 | 28 |
| *c* | *Mr* | 36 | 4 | 8 | 44 | 8 |
| | *Da* | 52 | | 4 | 40 | 4 |
| | *Le* | 36 | | 4 | 20 | 40 |
| | Totals | 216 | 4 | 52 | 148 | 80 |
| | *Er* | 12 | 36 | 40 | 12 | |
| | *Ry* | 12 | 68 | 20 | | |
| *d* | *Mr* | 4 | 76 | 8 | | 12 |
| | *Da* | 4 | | 96 | | |
| | *Le* | | 84 | | 12 | 4 |
| | Totals | 32 | 264 | 164 | 24 | 16 |

Figures will appear one after another in groups of four. Each member of a group will appear briefly and in isolation. Make your report in two distinct parts. First, give a description of product, as in the last series. Secondly, be on the alert to report any functional differences in performance with respect to the four figures within a group. Recognition of the figures is immaterial.

Before exposing the first member of any new group, *E* prefaced his 'ready-now' signal by announcing "new group." In order to facilitate *O*'s task in both series, *O* had before him at all times a copy of the formal instructions, including the six suggested descriptions of product indicated above.

*Results of Series 1.* Table 1 gives frequency of characterization of product as a function of the type of drawing employed. Since the series as a whole

falls into four groups of twenty-five members each (the *a*, *b*, *c*, and *d* set-members of Figs. 3, 4), each entry represents a percentage of 25 reports. The literal headings of the vertical columns mean (from left to right) *jld*=just a line drawing, *cpo*=concrete particular object, *gmc*=generalized member of a class, *sse*=something which stands for something else, and *cd*=conventionalized drawing. •

Here are important uniformities. (1) The more detailed and realistic the drawing, the more often is it reported as a concrete particular object. The *a* and *d* groups follow this rule, (*Da* constituting an exception to be discussed later). (2) Drawings of a certain limited degree of conventionalization (*b* drawings, with scanty detail) tend to be apprehended as generalized or abstractive objects. (3) Drawings of a high degree of conventionalization (half of them unnamed) tend to fall either under the first or the fourth characterization, *i.e.* are apprehended either as unnamed line-drawings or are taken in a way approaching the 'symbolic.' The totals for all *O*s, distributed according to type of functional product, make it appear that the only type of drawing whose characterization in product is relatively unstable is *b*, and even here the summed reports for *gmc* and *cd* include almost two-thirds of all. Notable is the relatively high number of reports on type *b* as *sse* (symbolic reference). This result may be accounted for by the very high schematization of some of the *b*-drawings.

Exactly what do these percentages reveal? Consider that we have somewhat controlled the scope of observational activity by setting down in formal instruction certain characterizations to which the *O*s pretty fully limited themselves, although they were free to suggest characterizations which differed from those offered. Again, observe that these characterizations were taken from free reports of our *O*s in Part I (Series 1).

That these descriptions of product are by no means arbitrary is shown by the high degree of agreement among the 5 *O*s. Although differences in emphasis occur, nevertheless the general trend shown by the totals is clear.

The outstanding exception is *Da*, whose reports on the *a* and *d* drawings cluster around *gmc* instead of *cpo* as the others do. Comments by *Da* during the course of his observations make it appear that *Da* apprehended, through an appropriate self-instruction, even the most realistic of the patterns as this or that *kind of drawing* of a well-known object, instead of directly as this or that object itself. Thus *cpo* was never an appropriate product. For him, all were simply 'pen-and-ink drawings.'

The results of Series 1 afford a partial answer to one of the questions raised at the beginning of the section. This question touches the correspondence between modes of performance, as set forth in Part I, and varieties of visual pattern. Our four or five different modes of apprehension—that is to say—make their appearance under unlike conditions of

retinal excitation. By careful design of our visual patterns, we can, therefore, govern to some extent the kind and product of performance. Furthermore, we have, in a preliminary way, indicated the occasional setting which leads on to a kind of symbolization. Under the conditions of this series, symbolizing appears where an object is denuded of detail until, in its poverty, it tends to point beyond itself in one or another direction. Under these conditions, the drawing tends to be apprehended as a surrogate for a

TABLE II

SERIES 2. FIVE KINDS OF FUNCTIONAL PRODUCT: WITH CONTEXT
(PERCENTAGES OF 25 REPORTS: CF. FIGS. 3, 4)

| Drawing | O | *jld* | *cpo* | *gmc* | *sse* | *cd* |
|---|---|---|---|---|---|---|
| | *Er* | | 44 | 56 | | |
| | *Ry* | | 96 | 44 | | |
| *a* | *Mr* | | 92 | 44 | | 4 |
| | *Da* | | 4 | 96 | | |
| | *Le* | | 100 | | | |
| | Totals | | 336 | 160 | | 4 |
| | *Er* | | 8 | 68 | | 24 |
| | *Ry* | | 8 | 20 | | 72 |
| *b* | *Mr* | | | 16 | | 84 |
| | *Da* | | 4 | 68 | 8 | 20 |
| | *Le* | 4 | 12 | 8 | 16 | 60 |
| | Totals | 4 | 32 | 180 | 24 | 260 |
| | *Er* | 24 | 4 | 60 | | 12 |
| | *Ry* | 20 | 4 | | | 76 |
| *c* | *Mr* | | | 12 | 4 | 84 |
| | *Da* | 16 | | 8 | 60 | 16 |
| | *Le* | 12 | | | 44 | 44 |
| | Totals | 72 | 8 | 80 | 108 | 232 |
| | *Er* | 4 | 40 | 52 | 4 | |
| | *Ry* | 4 | 80 | 12 | | 4 |
| | *Mr* | | 92 | | | 8 |
| *d* | *Da* | 4 | 12 | 84 | | |
| | *Le* | | 100 | | | |
| | Totals | 12 | 324 | 148 | 4 | 12 |

class, although, as in many cases, the class is not itself named. This mode of *symbolic apprehension* occurs most frequently with elliptical and foreshortened drawings (type *c* of Figs. 3, 4).

*Results of Series 2.* The results of Series 2 supplement those of Series 1 in three well-defined ways. In the first place, they enable us to check the distribution of characterizations presented in Table I by another set of materials. Secondly, they extend our knowledge of *the rôle of context* in the apprehension of objects; for the drawings are now apprehended as members of a group rather than in isolation. Thirdly, the new results extend

our information upon the development of symbolic comprehension and the functional utilization of symbolic objects.

Table II summarizes the protocols of Series 2 so far as description of product is concerned.

Comparison of the totals in Tables I and II reveals certain important differences in performance which have come about as a result of re-grouping. Remember that in Series 2 the four members of each set or group now come in immediate sequence but in various orders. Under these conditions, where the individual drawing is no longer apprehended by itself but as a member of its group, certain significant changes occur in activity and product. The more fundamental shifts in distribution occur with respect to *b* and *c*. In Table I the largest number of reports on *b* fall at *gmc* (156) with *cd* standing next (140). In Table II *cd* (260) takes more than *gmc* (180). Again, the class *jld*-objects were most frequent for *c* in Part I (Table I); but here (Table II) the class *cd*. No consistent changes (save in *cpo*) are apparent in *a* and *d*, although we had anticipated that re-grouping would have a marked effect on *d*, the 'symbolic' objects. The amount of

TABLE III

LOSSES AND GAINS (TOTALS) IN SERIES 2 OVER SERIES 1

| | *jld* | *cpo* | *gmc* | *sse* | *cd* |
|---|---|---|---|---|---|
| *a* | − 4 | +12 | − 4 | − 8 | + 4 |
| *b* | − 24 | −44 | +24 | −76 | +120 |
| *c* | −144 | + 4 | +28 | −40 | +152 |
| *d* | − 20 | +60 | −16 | −20 | − 4 |

shift in each classification for each kind is shown in Table III, which gives gains (+) and losses (—) in the results of Part II.

The largest gains shown in Table III are under the *cd* rubric of drawings *b* and *c*, balanced by corresponding losses respectively in rubics *sse* and *jld*. On the other hand, drawings of the types *a* and *d* show no significant changes, save a degree of accretion in rubric *cpo* of *d*.

What are the implications of these changes in the characterizations of our *O*s as we pass from Series 1 to Series 2? The shifts are obviously a function of re-grouping. The character of the organization of Series 1 had led us to the assumption that the individual members were perceived in a fairly isolated manner; that, in fact, they were not apprehended as 'members' at all, but simply as unrelated objects. The lack of stability in the characterization of the *b*-figures, combined with the relatively high incidence of reports of *jld* in the *c*-group, appear to warrant this assumption. On the other hand, in Series 2 the occasion of presentation, combined with certain features of the formal instructions, made it inevitable for *O* now to appre-

hend the various objects as *members* of a set. In the first series such references as *O* made beyond the immediately presented figure were rarely to other figures of the series. In the present series practically all references beyond the figure now become limited to a definite region, and the content of the region is specifically the *other members* of the particular set. It should not surprise us, then, that the abstractive mode of apprehension makes its appearance much more frequently in Series 2. Whereas in the former series a drawing meager in detail might be taken simply as a line-drawing or as a generalized representative of some class, in the present series the same figure is most often apprehended as a conventionalized drawing of a particular object as seen before. The relation between the *a*-drawings and both *b* and *c* is now quite specific and is expressed by a transition from the depictive to the abstractive mode of apprehension.

A totally unexpected result was the negative effect of re-grouping upon the apprehension of the *d*-drawings. It will be recalled that these drawings had been designed to 'represent' or to 'symbolize' the object of each set. In the case of *d*, the object of the first three drawings of each set was never actually included but simply implied by the use of one device or another. The results of Series 1 were quite in conformity with the general make-up of the series. If the various drawings were apprehended in an isolated fashion, it would be logical to expect that the *d*-drawings should be reported as concrete and particular objects and events. This is exactly what occurred. On the other hand, in Series 2 where the various drawings are no longer apprehended in an isolated manner, we expected that the symbolic character of *d* would become apparent, and that its description would shift from *cpo* to *sse*. As may be seen from Table II, this did not occur. On the contrary, the number of *cpo* reports actually increased slightly in Series 2 (Table III). This result suggests that the common notion of a symbol, to which we had tentatively subscribed in making our designs, requires correction.[28]

This quantitative examination of our protocols, taken under the instruction to "look for functional differences among the members of a group," calls for supplementation, which we shall seek under two topics; *(1)* the rôle of context in grouping, and *(2)* the symbolic character of the *d*-drawing.

*(1) The rôle of context in grouping.* Our reports suggest several means by which the changes in characterization noted in Series 2 took place. These means may be *(a)* a change in apprehension due to explicit memorial refer-

[28] A fuller account of the manner in which these *d*-designs were actually apprehended in Series 2 will be found in our discussion of functional differences.

ence to a preceding member of the set; *(b)* a direct influence of perceiving an earlier on perceiving a later member of a set, with no true memorial reference; or *(c)* the elaboration of a topic for each set which guides apprehension of the individual members. We discuss these in order.

*(a) Memorial reference.* This procedure is typical of the early part of Series 2. *O*'s initial apprehension of the figure is succeeded at once by remembrance of the member of the set exposed just previously, involving an attempt to compare the two and to discover whether the first perception was adequate. Examples follow.

*Er: gmc.* (1) Perceived (*jld*); (2) memorial reference to first member; 'flash' (that's what it is); (3) perception (lamp—*gmc*). (10*c*, preceded by 10*a*)
*Ry: cd.* (1) Perceived (*cd* of aeroplane); (2) memorial reference (to propeller); (3) comment (this relationship not the same as in last group). (5*b*, preceded by 5*d*)
*Mr: cd.* (1) Perceived (turtle—*gmc*); (2) memorial reference (to 1st and 3rd drawings); (3) Perceived (pig—*cd*). (4*b*, preceded by other three of set)
*Da: gmc.* Comment ("figure at first imperfectly perceived, but nature of series suggests that it might be a wall-switch"). (10*d*, preceded by 10*a* and *c*)
*Le: cd.* (1) memorial reference (to paper on room in last drawing); (2) Perceived (wallpaper design—*cd*). (9*c*, preceded by 9*d*)

*(b) Direct influence of earlier perceiving.* As frequent as the memorial reference was the influence of perceptive trend or 'set,' as initiated by a preceding member. This event was most marked with the *c*-drawings and somewhat less frequently in *d*.[24] Typical reports are the following:

*Er: gmc.* (1) perceived (jug); [this apprehension under set from the first member—no memorial reference]. (22*c*, preceded by 22*a*)
*Ry: cd.* (1) Perceived (Santa Claus—*cd*); [occasional instruction]; (2) self-instruction (to see figure as it is). (25*c*, preceded by 25*a* and *b*)
*Mr: cd.* (1) Immediately perceived (as belonging to same class as first—*cd*); [I should not have perceived it as a member of that class had I not seen the first two]. (13*c*, preceded by 13*a* and *b*)
*Da: gmc.* (1) Perceived (drawing of aeroplane); [if not for previous presentation probably wouldn't have been perceived as aeroplane]. (5*b*, preceded by 5*d*)
*Le: cpo.* (1) Perceived (cartoon with two figures, one man smoking); (2) query (what connection?); [it wouldn't occur to me that the man was smoking anything but a pipe, although his back was turned]. (11*d*, preceded by 11*b*)

*(c) Elaboration of topic.* As set after set of Series 2 is presented, *O* soon develops a topic or subject to characterize each set and to this the members of the set variously relate. This activity implies a definitely higher

[24] The importance of perceptive 'trends' and 'sets' is being recognized more and more in recent accounts of perceiving. Application of the techniques developed in our experiments should prove a fruitful way of providing a fresh and productive approach to the study of these basic aspects. For suggestive accounts of the significance and importance of 'perceptive trends,' cf. W. Neuhaus, Experimentelle Untersuchung der Scheinbewegung, *Arch. f. d. ges. Psychol.*, 75, 1930, 315-458: W. S. Neff, A critical investigation of the visual apprehension of movement, this JOURNAL, 48, 1936, 1-42; H. P. Weld and S. Feldman, Perceiving, Chap. 12 in Boring, Langfeld and Weld, *Psychology*, 1935, 274-299.

level of performance than that evinced in *(a)* and *(b)* above, *i.e.* a perceiving conditional upon remembering and upon a non-apprehensive carry-over. The nature of this effect is relatively simple and easily managed by the organism. In the elaboration of a topic, however, *O* has passed beyond a mere relating of figural products. The individual figure is now apprehended in terms of its relationship to a *topic*. This difference is significant and implies the operation of a more developed form of activity than those which so far have made their presence apparent in our experiments. Illustrations will serve to make the distinction clear.

*Er: gmc.* (1) Flash (Ah, topic lamp—another phase!); (2) comment ("something else to do with lighting"). (10*d*, preceded by 10*a* and *c*)

*Ry: cpo.* (1) self-instruction (to relate); (2) comment (it has to do with fire); (3) flash, unsatisfactory, because this is an object which has to do with a different sort of fire). (14*d*, preceded by 14*a*, *b*, and *c*)

*Da: gmc.* (1) Perceived (man with band on arm); (2) query (why in 'death' series?); (3) comment (must be a pallbearer). (18*d*, preceded by 18*a*, *c*, and *b*)

*Le: cpo.* (1) Perceived (reading-test); (2) comment (this is what you look at when your eyes are tested for glasses); (3) comment (not so closely bound up as others, but of course it still relates to vision and visual defects). (15*d*, preceded by 15*b*, *a*, and *c*)

*(2) Symbolic character of d-drawings.* In our quantitative treatment of Series 1 and 2 we mentioned *d* as an apparent anomaly with respect to the effects of re-grouping. We had anticipated that when *d* is apprehended in terms of the 4-set of which it is a member, instead of being taken as an isolated figure, a shift would occur from *cpo* to *sse* in its apprehension. But this shift did not appear. Shall we assume, then, that the *d*-drawings are apprehended in exactly the same way as the *a*-drawings?

Examination of our protocols reveals that, although the *d*'s are commonly apprehended as concrete and particular, their functional position in the set varies widely from that of the *a*'s. Quite early *O* realized that the existence of *d* in the set required some sort of explanation. The *a*-, *b*-, and *c*-drawings he regarded quite simply as various stages of conventionalization of an object, exercise from Part I probably helping him here. The presence of the *d* in the set, however, immediately generates a new task. Without formal instruction, *O* begins to inspect for some connection or relation between *d* and the other members of a set. This task *O* resolved by establishing a variety of possible relations. Upon examining these relations in some detail, we shall find that they may be arranged in order from a form which is not symbolical at all to a relation which is very close to, if not identical with, a symbolizing.

The relationships discovered by our *O*s to exist between *d* and the other set-members may be divided into two distinct groups. In the first group fall what we shall call internal relations. Here *d* has a specific relation to

other members. In the second group, the group of external relations, *d* stands in an indirect relation to other members but it falls under a *topic*. This difference is parallel to that between a purely depictive kind of apprehension and a symbolic variety.

*(a) Internal relations of d to a, b, and c.* This relation is typically carried by the comment "it fits in with the others." We made out two main kinds of 'fitting-in.' In one *d* is seen merely as a *part* of the object represented by the other members, *e.g.* the anchor of Set no. 6 (Fig. 3) was apprehended by all our *O*s as "part of the boat," and the propeller of Set no. 5 as "part of the aeroplane." Much more frequently, however, quite a different sort of relationship was developed, although it is still of an internal kind. The other 'fitting-in' we shall term *instrumental*. Here are instances:

*Ry: cpo.* (1) Perceived (man leaning out of window); (2) memory (first two drawings); (3) comment (he's shooting cats—no cat seen). (23*d*)
*Mr: cpo.* (1) Comment (it belongs to first two; it would turn on the lamps). (10*d*); *cpo.* (1) comment (related to others: they were dogs and they could live in this house). (8*d*)
*Da: gmc.* (1) Perceived (somebody throwing something); (2) comment (he must be throwing something at the cat). (23*d*)
*Le: cpo.* (1) Perceived (doormat); (2) comment (this lies on doorstep of first house). (7*d*); *cpo.* (1) Perceived (Xmas stocking full of toys); (2) comment (probably came out of Santa Claus's pack). (25*d*)

The instrumental relationship implies that *d* is apprehended as an agent or instrument for doing something to or with the object of the other members of the set. It is very far from being symbolic in the sense of 'standing for' that object. On the other hand, this instrumental relationship represents a step away from the relatively adventitious *part*-relation in the direction of the surrogative form.

*(b) External relations of d to a, b, and c.* It is in references of this second type that we approach much more closely the sphere of the symbolic. The physical boundaries set previously by the drawings of the set begin to be transcended. The *d*-drawings now relate, not to one or another of the three other figures but to a general topic. So, for example, the article of luggage (19*d*) is not merely something carried on the steamship represented (19*a*), but is *another instance* of the general topic of ocean travel. Reports will clarify.

*Er: gmc.* (1) Perceived (picture of Father Time); (2) comment (task double: either to look for something about clock or something to do with *time*—first task discarded). (20*d*)
*Ry: gmc.* (1) Perception (sort of picture seen at New Year); (2) self-instruction (compare significance with last picture); (3) inspection (both have to do with time. (20*d*)
*Mr: cpo.* (1) Memorial reference (to first drawing); (2) comment (relation clear

because man eating heavily and his expression implied that he was making a pig of himself.) (4*d*)

*Da: gmc.* (1) Perceived (number of figures); (2) comment (must have something to do with drunken orgy). (17d)

*Le: cpo.* (1) Perceived (reading test); (2) comment (this does not fit in logically with rest of series; at least it's not so closely bound up as others; of course, it still relates to vision and visual defects). (15*d*)

This relationship to a topic may develop to such a degree that *d* actually *carries* the topic merely represented by the other drawings; *i.e.* if, as in some cases, *O* shows doubt and hesitates before a choice among several possible topics, the apprehension of *d* may serve to establish the dominant topic of the set.

*Er: cpo.* (1) Perception (Xmas stocking); (2) comprehension (elaboration of general topic 'Christmas time' and all its appurtenances). (25*d*)

*Mr: cpo.* (1) Comment (related to first three in that band on arm suggested death as well as the skulls represented it). (18*d*)

*Da: gmc.* (1) Perception (fireman's helmet); (2) comment (the first three figures were all fires or connected with fires). (14*c*)

*Le: cpo.* (1) Perceived (dog-house); (2) comment (the last *must* have been a dog). (8*d*)

The results of Series 1 and 2 taken together lend support to the conclusions derived from the earlier section of our experiments. Approaching the question of transitional modes of performance between perceiving and comprehending from quite a different angle, the results of the present series give additional evidence that we are dealing here with quite distinct modes. We have been able to correlate the appearance of the depictive, figurational, abstractive, and generalized varieties of apprehension with certain types of drawing when exposed under a particular array of conditions. Furthermore, we have been able to study the changes in apprehension and the modes of apprehension utilized as the figure seen becomes one of a group, instead of appearing as an isolated object. This last result leads to the generalization that not only is the *type* of object a decisive circumstance in perceiving but also its position in, and relation to, other objects with which it appears bound-up. Finally, we have been partially successful in studying the course of development of symbolic reference. The relationships assumed by *O* to connect *d* with the other members of a set constitute a series of stages, the last of which closely approaches the true symbolical character. In distinguishing relationships *within* from relationships *beyond* the group, *O* goes beyond a mere associative reference to other objects. That kind of relationship wherein a *d*-drawing functions as a 'carrier of a topic' approaches—under the conditions and limitations set by our materials—the symbolical sort of performance of which we had earlier received hints. Moreover, our Series 1 and 2 prepared *O* for certain essential observations in later series, as we shall presently see.

*Series 3 and 4. Symbolical comprehending.* At the beginning of Part II we had set ourselves three problems. Two of these problems—the conditions underlying our four modes of perceptive apprehension and a description of their functional products—we have discussed in the preceding pages. Within the limitations of time and technique we have given at least partial answers to the questions raised. The third problem, however, treated only incidentally in the first two series of this section, is still unresolved. This third problem raises the issue of the existence and the character of a real symbolical mode of activity.

It will be recalled that the series of 100 figures designed for Part II, includes 25 drawings (the *d*'s of Figs. 3 and 4) drawn in a 'symbolizing' way. So far as the experimental materials are concerned, this term 'symbolizing' only means that, under appropriate conditions, the *d*-drawings may somehow imply or stand for the other three drawings (*a, b,* and *c*) of the set. The assumption originally made (the beginning of Part II) was that, if *O* tended eventually to regard the *d* as a surrogate or *sign* for the object common to the set, we should have evidence for a distinct symbolizing mode and should be in a position to study the character and conditions of this mode.

As we have just now seen, this 'taking-as-a-surrogate-for' was not precisely achieved. We did find that *O* apprehended *d* as bearing various relations to the other figures of the set. Certain of these relations were not at all of the symbolic type, *i.e.* those referred to as *part* relations and *instrumental* relations. But others did approach the surrogative form. When *d* refers to the *topic represented* in the set and when *d* is a *'carrier of the topic,'* the symbolizing form is approached.

Series 3 and 4 were designed to bring us still nearer to this elusive performance of the organism.

*Procedure and materials.* In Series 3 we utilized only the 25 *d*-drawings of Figs. 3 and 4. These were exposed in the tachistoscope. The time of exposure for each was increased to 2 sec. Instructions were as follows.

I am going to show you a number of figures. They will not appear in serial order. Observe and report upon each. Describe course of performance during exposure. Perceptive details are immaterial.

In Series 4 all of the drawings of Figs. 3 and 4 were again employed, but they were arranged in what was to *O* a novel manner. In all preceding series *O* had seen only one figure at each exposition. Any grouping or relating of the figures produced had therefore to be temporal in nature. In Series 4, however, this plan of sequence is abandoned. Now all the members of a set appear together at the same time. The manner of their spatial arrangement was carefully planned. The *a, b,* and *c* of each set stand in lateral sequence in the upper half of the exposure-field in the order named from left to right, and the *d*-drawing occupies

an isolated position in the central part of the lower half of the field. For Series 4 the instructions take the following form.

Several figures will appear together at one time. Describe course of performance during exposure as before.

*Results.* The results of Series 3 and 4 must be considered together. Remember that *O* had had a long acquaintance with the drawings in the preceding series. Upon this circumstance the experimenter counted. Again, consider that *d* had stood in a unique set of relations to *a, b,* and *c*. It had been a 'special member of the group.' Here, however, we have tried to devise a situation in which *O* would tend to regard *d* as a surrogate or sign of something quite different from itself.

In Series 3, each *d* was exposed by itself for 2 sec., with a very general formal instruction to report upon the course of performance during this prolonged exposure, thus tempting *O* to refer backward to the other members of the set. Our interest lay in the nature of this free reference. Series 4 was designed to make more specific the results of Series 3 and to extend them. Although the entire set now appears together, the occasion is limited in a strict way by an occasional instruction: *d* now occupies a dominant and significant position on the field, well designed to create a fundamental difference between *d* and the other three drawings.

The results of Series 3 may be summarized in terms of the five kinds of *reference* which *d* variously aroused. These are *(1)* generalized reference to the past, *(2)* a regional memorial reference, *(3)* a specific memorial reference, *(4)* a topical reference and *(5)* a symbolical reference. We shall treat each as regards experimental evidence and implication.

*(1) Generalized reference to past.* In this most elementary form of reference beyond the immediate event of presentation, the figure is perceived as something seen before—as familiar, in the vulgar sense. There is here no reference to any particular set in which this present figure had appeared. Following this generalized apprehension, a casual noting of details fills out the exposition-time. Some reports:

*Er:* Apprehended (as *that* figure); inspection (of details). No overt reference to previous apprehension beyond that implied in recognition as *that* and task. (21*d*)
*Ry:* Perceived as familiar, with no reference to other drawings; inspection (of detail). (4*d*)
*Mr:* Perceived (drawing seen before); inspection (details). Search (to remember set with which it had been given before): negative outcome. (22*d*)
*Da:* Perceived (as familiar); inspection (read writing on book). (3*d*).
*Le:* Recognized (head and letter V); self-instruction (to recall group) unsuccessful; comment ("I've seen this head a number of times before"). (22*d*)

Obviously this generalized reference constitutes a first departure from mere perceiving.

*(2) Memorial reference.* This form of activity was very frequent. The object is apprehended as the drawing which before 'went with' this or that

group of objects. The kind of object represented by the set is usually referred to in words. The figure is taken merely as 'a member of that set;' its position in the set is not considered.

*Er:* Object apprehended and recognized; memorial reference (to aeroplane series); (implicit memorial reference—merely reinstatement of that time); random inspection. (5*d*)
*Ry:* Apprehended (as familar); comment (this had something to do with cats before); inspection (for detail). (23*d*)
*Da:* Perception (familiar figure); comment (this shown with other figures having to do with Indian). While reporting came comment (bow and arrow). (1*d*)
*Mr:* Recognized (as one of former group—Father Time); remembered (had appeared before with group of clockfaces). (20*d*)
*Le:* Perception (Xmas stocking); memory (seen before in series with pictures of Santa Claus); casual inspection. (25*d*)

The figures are apprehended merely as objects which 'went with' a particular group; there is no surrogative aspect.

*(3) Specific memorial reference.* An elaboration of (1), but with a concrete memorial reinstatement of the actual members of the set.

*Er:* Perceived (familiar scene); memorial reinstatement of last time seen (with other figures); whole set run through in elliptical form. (14*d*)
*Ry:* Named verbally ('bird-house'); brief visual reference (to conventionalized bird with which it had appeared before). (16*d*)
*Mr:* Recognized (as familiar); comment ("it's a shoe tree"); visual remembering (shoes seen with it before). (14*d*)
*Da:* Perceived (familiar figure—stocking filled with toys); memorial reference (to Santa Claus series) with visual remembering (some of Santa Claus pictures). (25*d*)
*Le:* Perception (reading-test); comment ("has something to do with disorders of the eye—oh yes, it was spectacle series"); visual remembering (two of spectacle drawings). (15*d*)

This third form of reference departs still further away from the perceived object or scene. The present event becomes little more than an occasion for remembering. It functions as a pointer, picking out one or another object seen before. The reference here by no means transcends, however, the presented series. Remembering is always of one or another drawing seen before in the experiments.

*(4) Topical reference.* Here the relation to previous figures becomes less direct. The drawing is now apprehended as that figure which had to do with a certain topic (ocean travel, fire, or time). The fact that this topic was carried by a particular set of drawings becomes relatively incidental. Typically, however, the topic becomes the occasion for a verbal or visual memory of the drawings originally representing it; but this addition to the performance appears subordinate.

*Er:* Apprehended (as something to do with 'light' topic); inspection (of details); query ("is it on or off?"); task satisfied. (12*d*)
*Ry:* Task (reinstatement of query of last series as to whether these words spelled anything); just after end of exposition came reference (to spectacles). (15*d*)

*Mr:* Perceived (as familiar); perceived (as propeller) and with that came meaning 'aeroplane'; latter occasion of remembering (figure of aeroplane seen with it). (5*d*)

*Da:* Perceived (familiar figure); comment ('circus series'); further comment ("this has to do with drunkenness"); latter occasion for remembering (this is part of drunken series). (17*d*)

*Le:* Recognized (handbag); occasional instruction (to remember what series); comment ("this bag in series in which it did not fit exactly—other objects not handbags but something to do with travel; oh yes, it was ocean liners"). (19*d*)

Thus far we confirm the results of our former essays to find and describe 'symbolizing.' In 'topical reference' the object is not apprehended directly, but in terms of its relation to something quite different. In the most significant form, the object itself is relatively incidental; its functional value lies in the fact that it is the *carrier* of a topic, that it is a convenient means for dealing topically with things. At the same time, if we agree that a fundamental property of the symbol is its conventional and non-representative character—the prevailing opinion among most students of the symbolic—this topical reference just escapes the symbolic. Although we have gone away a good distance from the object, the object still remains as one of the items included in the topic. The handbag, for example, is a thing involved in ocean travel, and, as such, it may carry the topic but there still remains a concrete relation between the two.

*(5) Symbolical reference.* It is with the appearance of this procedure that we reach the goal set by our experimental inquiry. The object is now apprehended as bearing a significance beyond what it actually depicts. There is now no necessary relation between the perceptive details of the object and the sort of significance which it carries. Our *O*s speak of the figure carrying a 'double meaning;' one of these 'meanings' refers to its perceived characteristics, while the other signification represents a reference to something quite different. It is while possessing the second signification that the object may be said to be 'standing for, or suggesting, something else.' The figure is no longer merely one of the items to which a topic refers. The figure is taken in the present case as a *surrogate,* as a substitute for a class or subject. It is 'symbolic' in the sense that its own properties as an object are immaterial to the reference. *O* has come to a place in performance where *'this* thing means *that.'* Protocols serve to make the distinction clear.

*Er:* Apprehended (as one first called 'nightmare' and later called 'pink-elephant phenomenon'); memorial reference to first and second times object perceived (this reference carried with it the double meaning of the object and the fact that the second meaning was brought by the group with which it appeared). (17*d*)

*Ry:* Perceived (as familiar); no reference to any other objects; inspection (details never noticed before and reference to pipe—which drawing had not had previously). (11*d*)

*Mr:* Perceived (not only as familiar but as drawing that went with others—it

meant 'bird' as well as 'birdhouse'); later there was memorial reference (to particular birds seen). (16*d*)

*Da:* Perceived (familiar figure); comment ('pall-bearer'); remembrance in verbal terms (perceived originally as military policeman). (18*d*)

*Le:* Perception (man smoking); comment ("there's something significant about fact that man's back is turned and that I see only smoke—oh, yes, I remember commenting that man is smoking a cigar and I wouldn't have known it if not for previous observation"). (11*d*)

These five types of reference may be taken to constitute stages in a movement from ordinary perceptive apprehension toward the activities of comprehending. In the two last varieties—topical and symbolical reference—we may already be in the sphere of a non-apprehensive performance.

Although our results in Series 4 are not entirely satisfying, they constitute an interesting addition to, and culmination of, our experiments. It is quite clear that a process of remodeling has been carried out with respect to the various members of the set. The *a*, *b*, and *c*-figures tend now to be taken together, while the *d*-figure is considered as of a different order and status. The first three figures (taken all together and integratively) *are* the topic or, at the least, are *representatives* of the topic of the 4-set. The *d*-figure is typically something outside of the region of the topic, but bears a special and definite relation to it.

The results with reference to apprehension of the *d*-drawings are much more complicated. The fundamental question to be raised is, of course, whether they were apprehended in a symbolizing way—as Series 3 had led us to expect—or whether juxtaposition to the other members of the set broke down such an apprehension. Scrutiny of our protocols reveals, however, that these *d*-drawings were not apprehended in any single, unequivocal manner. In general, the four kinds of reference discovered in Series 3—the *part, instrumental, topical,* and *symbolical* types of reference—make their appearance in Series 4, as well. Since all the drawings are present at once, however, *O* is able here to describe these references in a more rigorous manner.

The function of *d* as topic-bearer or as symbolized also has a differentiating reaction upon the nature of *a*, *b*, and *c*. In the topical reference, all four figures on the card display a much higher degree of integration than when *d* becomes symbolical. In the former case, both the top row and the bottom figure 'go together' to form the topic, the only difference being that *d* (at the bottom) seems to carry the topical significance in a much higher measure than *a*, *b*, and *c* do. It is as if *d* made a statement ('ocean travel,' 'birds,' 'fire,' and the like) which the top figures elaborate or specify ('travel by ocean liner,' 'birds of this variety,' etc.). We appeal again to our evidence.

*Er:* With emphasis on the scene at the bottom, the 'flower' topic is set up more particularly than that present in the others; scene apprehended ("this is the way flowers come"), while top drawings specified (evolution of flower). (9)

*Ry:* Top row apprehended as more or less equally representative of topic; anchor (*d*) *stood for* topic 'boat,' whereas other figures *represented* boat. (6)

*Da:* Comment following inspection of lower figure ("clock") ("Father Time"). Brief inspection of lower figures with product (clocks in various degrees of detail). All figures related in the sense that they had to do with time. (20)

*Le:* Relation between switch and drawings of lamps carried by comment ("oh yes, a lamp switch—of course; they are all connected with illumination"). (10)

Quite different are the relations which appear when *d* is used symbolically. Then the top row and the lower figure (*d*) assume quite unlike offices. If we neglect detail, the fundamental difference can be stated as follows. When symbolizing, *d* appears to stand for (serve as a 'sign' for) a topic or subject. Functioning thus, it often displays a double signification; one being the topic, the other just the *d*-object as perceived. For example, 2*d* is both 'fishing' and a fish-hook; 3*d* both 'books' and a book-plate; 4*d* both 'hog' and a man eating. On the other side, the *a, b,* and *c* figures (above) are now simply three individual illustrations of that topic, several items in the same general class. They are not necessarily representative of the topic (as they were under the topical reference): they merely present for consideration several objects with which the topic has to do. Our *O*s tend to vary somewhat in the terminology which they use to describe this situation, but their performances are quite comparable.

*Er:* Immediate apprehension (whole field belongs to the same topic); this is carried by perception of lower figure, which is apprehended as symbolic of top row, *i.e.* it stands for everything which had to do with book; top row apprehended as secondary and simply more or less detailed items of that topic. (3)

*Ry:* The group was apprehended (as a whole, as that group dealing with boat); query (why 3 in a row and 1 below?) task (find out if all these groups have 3 objects directly dealing with the topic and 1 carrying it . . .). (6)

*Da:* Brief inspection of upper figures and comment ("fire"); lower figure apprehended (stands for fire—relation is clear). (16)

*Le:* Perceived (three fish and baited fishing-hook); comment ("obviously connected, but when I saw fishing-hook in last series I couldn't remember what it went with; I then commented it was either the hook or the worm that has a particular connection, but 'bait for fishing' not present before"). (2)

These detailed descriptions are obtainable in only a few cases, usually near the beginning of a presented series. The symbolic process usually becomes extremely telescoped and direct; so that it is difficult, if not impossible, to ascertain its nature. We are able to detect its presence, however, by the following circumstance. Comparison of the more elliptical with the more detailed reports indicates that where a comment descriptive of *d* apparently points the significance of the entire set we can be fairly certain that we are dealing with a symbolizing situation. Here are illustrations:

*Er:* Bottom figure apprehended (as Father Time, and as time in general); top

row apprehended as (times at which Father Time reaps—not apprehended as particular clocks at all). (20)

*Ry:* Here the group is apprehended as belonging together, and the belongingness seemed to be summed up in the single word "bird-house." (16)

*Da:* Inspected lower figure, with comment "hog;" similar comment following inspection of upper left-hand figure. Was aware that all the figures dealt with the topic "hog." (4)

In this stage we appear to have reached the final, the most concentrated and habituated, kind of symbolical reference likely to occur in this experimental situation.

When we turn to the literature for authoritative accounts of symbols and symbolization we are confronted at once with certain difficulties. Works dealing, directly or indirectly with symbols and symbolizing may be summed up under four quite disparate rubrics; (1) philosophy and (especially) logic, (2) linguistics, (3) the psychological study of language (or, more descriptive of some cases, the study of language by psychologists), and (4) studies representative of a recent trend in comparative psychology. In it all we find no serious consideration of the psychological activities of the normal human adult. Extensive perusal of the sources leaves us with the conclusion that the problem of 'the symbolic' has been sadly neglected by experimental psychologists, who have entered the problem from only two avenues of approach, the study of language and animal experimentation.[25] So far as we are able to ascertain, the present study represents the first attempt to deal directly with the psychological activities (omitting linguistic studies) displayed by the human adult when it is operating 'symbolically.'

We cannot deal exhaustively with the philosophical studies which bear upon, or professedly deal with, the symbolic. The fundamental problems raised by philosophers in their consideration of the symbolic are of quite a different order from that with which we are concerned. Substantially the philosophical treatments resolve themselves into a discussion of the relations between symbols and the things they symbolize and take on a directly epistemological or ontological character. Illustrative of this trend is Cassirer's long study,[26] which is quite representative of the neo-Kantian trend in recent German philosophy. Other treatments of the symbolic are those of Husserl, from the phenomenological approach (What is the *essence* of a symbol?)[27] and Ogden and Richards from a logico-linguistic direction.[28] The problem interesting to philosophers is not a consideration of how we symbolize, but rather an analysis of the place of such an entity as the symbol in a scheme of Being which they sustain.

Students of language (whether professional linguists or psychologists interested in language as a social performance) tend to take the symbol for granted. Consideration of standard text-books on language, such as those of Jesperson[29] or

[25] A careful search through the *Psychological Index*, from the first volume to the last, reveals not one study dealing experimentally with symbolic performances of the human adult, with the exception of certain derivative studies of the development of language.

[26] E. Cassirer, *Philosophie der symbolischen Formen*, 1923.

[27] E. Husserl, *Logische Untersuchungen*, 1900.

[28] C. K. Ogden and I. A. Richards, *The Meaning of Meaning*, 1923.

[29] O. Jesperson, *Language*, 1922.

Sapir,[30] reveals a complete lack of recognition of the symbolic as involving any problem at all. There is simply the tacit assumption that words *are* symbols and therefore the fallacious consequence that anyone using words is *per se* symbolizing. This error, of course, is not limited to professional students of linguistics. We must clearly distinguish between a logical or linguistical definition of a symbol and the psychological activity which is displayed by an individual when he apprehends an object as standing for or serving as a surrogate for something else. The distinction here is comparable to that held firmly by psychologists between the object which serves as stimulus and the object which is a product of perceiving.

Psychologists have carried on studies which approach the sphere of the symbolic, their efforts taking them in two quite divergent directions. On the one side, we have a group interested in language as a social function, which has devoted itself to the ontogenetic development of the use of words. On the other side, stands a small group of behaviorists who use the term symbolization to account for certain activities observed in the animal forms under observation. When the first group turns to experiment, it interests itself particularly in the general field of *Begriffsbildung*. Followers of Ach in Europe and certain American psychologists have attempted to create situations whereby they try to study the development of the use of an artificial language.[31] Here the symbolic significance is commonly the absent member of an originally connected series of items of an inherently meaningless character. The conception of symbolization developed in animal experimentation has become very influential in certain circles. It has been appealed to to account—in behavioristic terms—for the performances of animals involved in what is known as the 'delayed-reaction.' The men associated with this type of experiment assume that the period of time during which a particular animal can delay a certain operation and carry it on after the initiating stimuli are removed may be used as a measure of its symbolizing capacity.[32] It is their opinion that, after the period of delay, the animal proceeds to carry out his action in terms of a 'sign' or 'residual trace' of the original perception.[33]

It should be clear to the reader that we are using the term symbolical in none of these ways. We are interested not at all in what a symbol is, although we are careful not to identify the verbal with the symbolic. Neither are we prepared to commit ourselves on the question as to whether the delayed reaction in dogs or infants is a symbolic sort of performance,

---

[30] E. Sapir, *Language*, 1921.

[31] Important papers of this type are N. Ach, *Über die Begriffsbildung*, 1921; E. Achenbach, Experimental Studie über Abstraktion und Begriffsbildung, *Arch. f. d. ges. Psychol.*, 35, 1916, 410-568; E. Jacob, Über Entstehung und Verwendung der Begriffe, *ibid.*, 51, 1925, 495-539.

[32] W. S. Hunter, The delayed reaction in animals and children, *Behav. Monog.*, 2, 1913, (no. 6), 5-86, and The symbolic process, *Psychol. Rev.*, 31, 1924, 478-497; A. C. Walton, The influence of diverting stimuli during delayed reaction in dogs, *J. Animal Behav.*, 5, 1915, 259-291.

[33] For certain writers, the theory of 'signs' or 'symbols' forms an intrinsic part of their account of animal performance; cf. E. C. Tolman, *Purposive Behavior in Man and Animals*, 1932, 134 ff., 240 ff., and H. S. Liddell, The comparative physiology of the conditioned motor reflex, *Comp. Psychol. Monog.*, 11, 1934, (no. 1), 1-90.

beyond noting in passing the use of an obscure and ill-defined term (the symbolic) to describe a fairly common kind of activity. At the beginning of this section we raised certain specific questions which we have attempted to answer. We wished to know whether human adults could be involved in a situation which might lead them to apprehend an object not *qua* object, but as a surrogate for something quite different from itself. This we chose to call a 'symbolic' operation, because this surrogate sort of performance violates in no way the common definition of a symbol. We further wished to ascertain the characteristics of this symbolical sort of activity, provided that our *O*s displayed it, and to study certain of its conditions and issues. These aims we have in some measure accomplished. We have good evidence that our *O*s repeatedly apprehended certain objects (in particular our *d*-drawings) in a symbolic manner, *i.e.* they took these figures to represent or stand for something quite different from their visual appearance or character as perceived objects. We can, then, answer the first question raised above in a positive manner.

As regards the characteristics of this symbolic way of performing, our task is more difficult. Whether this kind of operation should be regarded as a mode of apprehending, as a transitional mode of performance between pereceiving and comprehending, or as a simple form of comprehending, is a problem which we shall discuss in the concluding section of this paper.

One interesting point before we leave this topic. Comparison of the results of Series 1 and 2 with those of 3 and 4 (Part II) reveals that two kinds of figures have been described as symbolical. In the final two series, the *d*-figure has been described as a surrogate form, while in the earlier series there was a fairly high incidence of reports of the symbolic at presentation of the *c*-drawings (cf. Table II). This situation becomes interesting when it is recalled that the *c*'s were simplified and abstract drawings, described either as conventionalized drawings or as being devoid of any significance whatsoever. How may we account for the fact that two entirely different kinds of drawings (*c* and *d*) elicit, in differing situations, reports of a symbolic character? The answer—so far as we can give it—seems to suggest the possible array of conditions as the basis of symbolizing activity. The clue rests both in the type of figure and the kind of situation. The *c*-drawings were apprehended as symbolic (in about a third of the cases) when all the drawings were being seen in an isolated fashion, *i.e.* when *O* was by no means aware that the various figures of the series fell into natural groups. We can assume with reason, then, that there was something about the characteristics of the figure itself, something about abstract design, which tends to arose a symbolic reference. On the other hand, there is nothing about the *d*-drawings which would lead to their resignation as symbolic and, in fact, we see that they were not so designated in the earlier series. In the case of the *d*'s, it had to be the *situation* which determined the symbolic character. It was not until the individual *d*-figure was taken as a member-of-a-set-of-figures, to the others of which it bore (presumably) some relation, that it began to arouse a 'symbolic' signification.

This phenomenon of a single way of performing in two quite different situations suggests that there may be various levels of symbolization and suggests, furthermore, that the conditions for this kind of psychological activity may be relatively complex. If we may resort to analogy, the first kind of 'symboling' (set off by our *c*-drawings) is comparable to the pictograms and idiograms which are assumed to be at the root of written language, while the second kind is akin to the far more conventional form of symbol represented by a blindfold figure with scales or a heavily armored man with black beard and heavy jowl brandishing a dripping sword. The analogy suggests, at the very least, an interesting program of research.

## Conclusions

A fundamental problem which has perplexed philosophers for centuries and psychologists for decades is that of the derivation of understanding from perceiving. When, toward the end of the 18th century, it became clear that an easy hypostatization of faculties could not be considered as an adequate psychological description, men began to cast about for other ways of explaining the 'higher mental activities.' The doctrine of association, as promulgated by the influential British Empiricists of the 19th century, constitutes one of the most elaborate and serious attempts to resolve this difficulty. Its purpose was, at basis, wholly laudable. It constitutes an attempt to account for 'higher' function in terms of 'lower,' to account for 'understanding' and 'idea' in terms of 'sensation' and 'impression.' Wundt's 'creative synthesis,' the *Produktionstätigkeiten* of Witasek and Benussi, the *Komplextheorie* of Müller, all constitute more or less sophisticated efforts to resolve the same problem.

The problem is, of course, real and pressing. A great many of the difficulties involved in giving a psychological account of perception have been resolved with fair satisfaction. When we consider the more developed psychological activities, however, variously described under the terms 'understanding,' 'cognition,' 'the intellectual processes,' 'thinking,' and 'reasoning,' we find that no treatment, even partially adequate, is anywhere to be found. Worse than this lack of a comprehensive and authoritative description (which time and industry could supply) is the circumstance that the approaches made to a solution of the problem have seldom been fruitful. The experimental attempts to cope with the problem (structural, behavioral and configurational) suffer from a common difficulty. They take little or no account of the actual character, conditions, and continuity of psychological performance.

Our own approach to the problem consists fundamentally of an attempt

to derive 'understanding' from those apprehending activities upon which we have much more well-founded information. Our technique has involved placing the human individual in a perceptive situation and attempting to discover how he moves away from perceiving in the direction of more developed—and possibly more involved—psychological performance. We have used the method of report throughout, checking our protocols wherever possible by quantitative treatment.

The most important result from our series of experiments is that perceiving itself requires re-definition. The activity of perceiving is not single, as has been the prevailing assumption among psychological theorists. It involves multiple activities; it is not a point in psychological performance but a region. We have discovered five differing modes or kinds of perceptive activity, each displaying different characteristics, resulting in different products or issues, and dependent upon different conditions. These we have called the *figurational*, the *depictive*, the *abstractive*, the *generalized*, and the *symbolical* varieties.[34] Quite possibly others might make their appearance under the influence of a more general experimental attack.

The implications of our discovery of these five types of operation are important for any study of the more developed psychological activities. These five modes of performance may be taken to constitute stages in a functional continuum from perceiving to understanding. The *figurational* and *depictive* forms closely adhere to the region of the object. The last three, however, depart from that sphere and strike out in increasing measure for new psychological regions. The *abstractive* variety takes the object as a representative of some other object; the *generalized* mode carries through a topical kind of reference, the object standing for a class, and the *symbolical* mode regards the object merely as a surrogate, as a 'sign' of some topic, subject, or other object quite different from that implied by its directly perceived characteristics. In the case of the latter, especially, do we

[34] It is a moot point whether these five types are to be considered sub-varieties or kinds of a more general activity of perceiving (the apprehension of objects present and going-on-now) or whether some at least should be endowed with the status of independent psychological operations. In terms of the distance which they proceed beyond the object, the last two (*generalized* and *symbolical* modes) might be taken as more developed activities, possible transitional forms between 'mere' perceiving and comprehending. This question may resolve itself at basis into a merely classificatory problem. At the same time, it appears to be true that the repertory of performance of the organism in a relatively simple situation is more varied than we had anticipated. We do find, of course, a variety of products, although this does not necessarily entitle us to assume a like plurality of functions. For an illuminating account of the interrelationships between 'function' and 'product,' cf. Madison Bentley, *The New Field of Psychology*, 1934, 12-23, 30-31, 360-364. A recent study dealing experimentally with the problems of functional differentiation is that of J. McV. Hunt, A functional study of observation, this JOURNAL, 47, 1935, 1-39.

border or enter upon the region of understanding, completing our journey from the modes of a direct commerce with objects.

The results of our experiments may be summarized as follows.

*(1)* In our search for the relation of perceiving to understanding we have distinguished five modes of apprehensive performance. These we have characterized as the *figurational, depictive, abstractive, generalized,* and *symbolizing* varieties. Under the conditions of our experiments, these five modes take the following forms.

*(a) Figurational.* The apprehension of a figure as an incorporeal line drawing.

*(b) Depictive.* The apprehension of a figure as a concrete, particular object.

*(c) Abstractive.* The apprehension of a figure as a conventionalized or schematized drawing of some well-known object.

*(d) Generalized.* The apprehension of a figure as a generalized member of a class of objects.

*(e) Symbolical.* The apprehension of a figure as a surrogate or 'sign' for something quite different.

*(2)* The conditions of appearance of these five modes differ. The *figurational* mode tends to appear with presentation of the most highly schematized drawings (Type *5* of Figs. 1 and 2 and Type *c* of Figs. 3 and 4). The *depictive* mode shows a high degree of correlation with presentation of the most realistic figures (Type *1* of Figs. 1 and 2 and Type *a* of Figs. 3 and 4). The *abstractive* variety appears most frequently with figures of a fairly high degree of conventionalization (Types *3* and *4* of Figs. 1 and 2 and Types *b* and *c* of Figs. 3 and 4). The *generalized* mode tends to make its appearance in terms of figures deficient in detail or type-like in appearance (Types *2* and *3* of Figs. 1 and 2 and Types *b* and *a* of Figs. 3 and 4). The *symbolizing* mode appears to be dependent upon a more complicated set of conditions than the others. When *O* is apprehending figures with no reference to other drawings of the series, he may tend to apprehend highly conventionalized drawings as symbolical. On the other hand, when figures are apprehended as members of groups, a highly realistic figure which bears a peculiar relation to the other members of the set may be taken as symbolic (Type *d* of Figs. 3 and 4, Part II).

*(3)* We have good evidence for the existence and importance of perceptive trends, the clearly defined influence of earlier upon later perceiving.

*(4)* In general, we have indicated the primary manner of derivation of 'understanding' from perceiving, our five modes constituting steps or levels from the most direct apprehension of objects to a consideration of their topical significance. Applications of our technique should prove fruitful in studies directed toward the more developed activities themselves.

# AN EXPERIMENTAL STUDY OF THE AFFECTIVE VALUE OF SOUNDS IN POETRY

By KATE HEVNER, University of Minnesota

Studies of the nature of poetry might be subdivided for convenience under three general heads: (1) the poetic image and idea; (2) poetic sounds, or the formal elements in poetry; and (3) the marriage of sound and meaning, or the relationship between the formal sounds and the thought. Psychologists, critics, and even the poets themselves have contributed much to our understanding of poetry in all three of these aspects, although certain of the studies are of more interest than others from the point of view peculiar to psychology. One particularly enlightening analysis has been made of the development of image and idea from nebulous beginnings to highly poetic expression.[1] The nature of rhythm both in prose and verse has been extensively explored and much has been contributed in recent years to our understanding of its pleasantness and effectiveness.[2] New explanations for the sources of pleasantness of tonal harmonies in vowel sounds have followed from the researches of physicists and philologists.[3] Careful studies have also been made both of the pleasantness and the symbolism of vowel and consonant sounds,[4] and the range of reaction to individual words as sounds and symbols, has been mapped in great detail.[5]

In relation to all these criticisms, discoveries, and analyses, the poet occupies a strange position. He has provided and will continue to provide all of the source material from which the conclusions may be drawn, yet he will probably be the last to benefit by them. For in creating his verses the poet is not conscious of all the rules or principles, not even conscious of something much less definite which we might call poetic tradition or custom. He is a person who is hypersensitive to language sounds, to the harmonies of vowels, the cadences in phrases, the patterns of repeated and contrasted consonants. Not only for image and idea but also as mere patterns

* Accepted for publication May 25, 1936. This study was financed by the research funds of the graduate school of the University of Minnesota.

[1] J. L. Lowes, *The Road to Xanadu*, 1930, 1-639.

[2] The work of Scripture, Wallin, Paterson, Griffith, and others is admirably summarized by A. R. Chandler in chapter 13 of *Beauty and Human Nature*, 1935, 238-276.

[3] Henry Lanz, *The Physical Basis of Rime*, 1931, 1-365.

[4] Louise Roblee, and M. F. Washburn, The affective value of articulate sounds, this JOURNAL, 23, 1912, 579-583; Edward Sapir, A study of phonetic symbolism, *J. Exper. Psychol.*, 12, 1929, 225-239.

[5] J. E. Downey, Individual differences in reaction to the word-in-itself, this JOURNAL, 39, 1927, 323-342.

of sound, the verses absorb his attention and ring in his ears. He can comprehend the progress and the digressions of the thoughts as they are carried by the sounds in much the same way that the layman is able to apprehend the two different but simultaneous processes in song—the words and the music. From long habit and practice, the poet "hears" the words as appropriate or inappropriate for the expression of his concepts, and the supreme esthetic thrill in creating must often come as a 'recognition' of the rightness of the verses with any conscious constructing or manipulating of the material entirely lacking.

Yet there must be some sort of system, some orderly scheme for using sounds to enhance meaning with such glorious effectiveness. Without it we could not explain the rapport which the poet maintains with his audience, and we are therefore forced to postulate a 'grammar' for the poetic form, a syntax which bears the same relationship to poetry that the English grammar bears to the language which makes up our daily conversation. Its influence is directed upon every heard phrase and every spoken sentence, yet the child of ten years who uses the language so fluently is quite bewildered by the very concept, and could not name a single element nor quote the simplest law. The grammar is entirely an afterthought, a rationalization of the functioning of the language. Observations have been made, tabulated, classified and systematized and have been helpful for those who wished to acquire the use of the language by short cut methods without the long and inefficient training necessary for acquiring it in the more natural manner. Likewise a discovery of the underlying principles of poetic form are of least interest to those who are most conversant with poetry and of greater importance to those who must be taught the appreciation of it.

The present studies represent an attempt to investigate this grammar of the poetic language—first to discover whether there is an underlying system which is generally understood, and secondly to trace the part played by certain elements of poetic form: (a) the vowel sounds; (b) the consonant sounds; (c) meter, and (d) voice inflection. In the light of previous studies on the affective value of word sounds, the present experiments have three distinguishing features: (1) they measure not only the pleasantness and unpleasantness of the sounds but also their affective qualities in such dimensions as happy-sad, exciting-quiet, delicate-ponderous, and dignified-humorous; (2) they study the sound effects as they are commonly found in poetry; and (3) they accomplish a complete isolation of the pure sound effects from the meaningfulness of the words as symbols. This means that the material which was presented for observation in these experiments had poetic form but no meaning, it made use of all of the factors which

distinguish poetry from prose—regular meter, end rhyme and internal rhyme, assonance, alliteration—but did not carry any image or verbal meaning of any kind. The only clues to the subject matter of the poems were those carried by the pattern of sound and rhythm and the inflections of the voice in reading them.

## Preliminary Study

The major series of experiments were preceded by some preliminary and exploratory work in the sound effects of poetry, and one of these earlier studies, because of its value for demonstration to students of esthetics and versification, will be described briefly.

*Method and procedure.* In searching for material to illustrate the poetic form in contrast to the poetic image and idea, the author worked out a kind of translation of some outstanding poetry into an imitative but meaningless sound, a parody of the poem, more or less exact, but with the ideas and imagery eliminated. The translation was made by leaving all the vowels in their original places in the rhythmic scheme of each verse and shifting the consonants so that the words could no longer be identified as words. Every consonant appearing in the line was used within the same line, and any alliteration or other repetition was retained wherever possible. The result was a combination of sounds resembling the original but carrying no verbal idea or image. When care was taken in making these translations, very harmonious verses would result and the listeners reported a pleasant experience in hearing them. They served a dual purpose: (a) they effected a complete isolation of sound from meaning for experimental purposes; and (b) they greatly facilitated the process of attending to the formal aspects of poetry for the evaluation of their effects, as distinct from message or meaning. Defects as well as excellencies stood out in sharp relief, and the appropriateness of the sound for the ideas or moods expressed by the words could be evaluated more readily. Especially when the listener had already familiarized himself with the words of the poem, was the divorce between sound and meaning helpful and effective in a critical evaluation of the poem. The marriage of sound and meaning in truly poetic verse results in a subtle interlocking, difficult to extricate after it is once accomplished, for the two factors react upon each other in a reciprocal fashion. The bare sound of the words is of course enhanced and emphasized by the meaning which they carry and the meaning is colored and shaded by the sound harmonies of the words. Two verses from Keat's *Eve of St. Agnes,* often quoted for their lovely sounds, are:

> And still she slept an azure lidded sleep
> In blanched linen, smooth and lavender'd.

In the first of these, the unusualness of the words "azure" and "lidded" make them important, and hence emphasize their vowel and consonant sounds—the long "u" sound, the caressing "z," the dull repeated "d" and the soft "r" and "l." With the attraction of the attention to these sounds, the inappropriate "st" and "pt" which occur earlier in the line are relatively ineffectual. Likewise in the second verse, the difficult and quite unharmonious "ch" sound fortunately occurs on an unaccented syllable and can be hurried over and lost among the more euphonious sounds in the line. In our translations, these same consonants would take somewhat different

places in the total sound effects of the lines and the student gains more insight into the interlocking of the word-sounds and their meanings by a method which effects a separation of sound and meaning so that the harmonies and the rhythms of the verse have only their objective qualities as auditory sensations to provide their effects.

Stanzas from several of the poems used in these studies will be reproduced here so that the reader may have a clear idea of the method. In offering these translations, the transcription is not given in phonetic symbols (since few readers are familiar with these symbols) but the vowels and consonants are marked systematically,[6] and in case of any doubt as to the pronunciation of a vowel sound, reference may be made to the corresponding position in the original verse.

From Keats, *La Belle Dame Sans Merci:*

Oh what can ail thee, knight at arms,
Alone and palely loitering?
The sedge has withered from the lake
And no birds sing.

Whō lŏttă nā thee, kīn ă tårms
Păl ōnăn tă lee doilering
Hăth wĕdgĕs thĭrĕd thŭm lĕ frāke
Săn dōn bŭrrs drĭng.

From Browning, *How They Brought the Good News from Ghent to Aix:*

I sprang to the stirrup, and Joris, and he;
I galloped, Dirck galloped, we galloped all three;
"Good speed!" cried the watch, as the gate bolts undrew;
"Speed," echoed the wall to us galloping through;

Spў tăng thĕttă pĕstĕr dăn hōr ănd jăzz ee
Dī plăgged, kĭr plăggĕd, thee plăggĕd wår lee
Crŭ deed spī thĕd bŏg thĕssă chāte wōl dă grŭ,
Three dĕs pŏd wee thåll *soot*ă plăggĕdĭng clŭ, etc.

From Walter de la Mere, *The Linnet:*

Upon this leafy bush
With thorns and roses in it,
Flutters a thing of light
A twittering linnet, etc.

Thŭpŏn bee leefĭss ŭsh
Theers wōrn dăss sōnĕth ĭnnĭt
Sŭll ĕrtă lĭngthă vĭt
Tălĭngĕră twĭnnĕt, etc.

From Thomas Hood (Sonnet) *Silence:*

There is a silence where has been no sound;
There is a silence where no sound may be;
In the cold grave, under the deep, deep sea,
Or in wide desert where no life is found, etc.

Săre ĭthă lĭwhĕnce, săre hăb sĕnthō nound,
Săre ĭthă lĭwhĕnce săre bō nound săy mee,
Thĭn tă grōld kāve, ĕrdŭndă seep, theep, dee,
Wōr dĭn tĭre sĕddă, năre fō while fee sound, etc.

The consonants are sometimes changed from the original to the translation, as from "c" to "k," when the hard sound of the "c" is indicated. Wherever possible

---

[6] The diacritical marks are: ō as in go, ŏ as in got, ā as in may, å as in father, ă as in sat, ee as in meet, ĕ as in met, ī as in ice, ĭ as in it, oo as in gloom, and *oo* as in foot.

an English word is used, and several syllables are run together when they are to be pronounced as one unit.

Copies of these translations were made with the verses of the original poetry interlined, so that the reader would have an ever present guide to the voice inflection.

FIG. 1. SHOWING THE ADJECTIVES ARRANGED IN EIGHT RELATED GROUPS

The pauses, the rises and falls in pitch and variations in accent which seemed appropriate to the original lines were given to the translated line. The reader then practiced two different renditions of each poem, the first one eloquent and exaggerated of the feeling and spirit of the poem, and the second one a more sedate modification of these original inflections. Phonograph recordings were made and the second interpretation, the less eloquent and dramatic was chosen in every case for the experimental material.

These recorded poems were then presented to groups of observers who were asked to report on the meaning. They heard one of the poems read twice, and during and immediately after the hearing they checked from a printed list of 64 adjectives all those which seemed to them to be appropriate to the poem. Because of the difficulty of this task the experimenter did not run the risk of using entirely naïve subjects for these studies. Without previous experience with experimental work in psychology, the subjects could not have been expected to maintain an objective, serious, and cooperative attitude. These studies were introduced as one of the regular class exercises near the end of the course in elementary laboratory at the University of Minnesota. The students had already participated in experiments in the affective value of colors, of musical intervals, and of longer musical compositions. They were told briefly the purpose of the experiment and the necessity of using an unfamiliar language. It was explained that French and German poetry could not be used because of the dissimilar poetic techniques and because of the possible clues afforded by occasional familiar words, and they were assured that the experimenter would put the poems and the phonograph records at the disposal of the class for individual study at the completion of the experimental series.

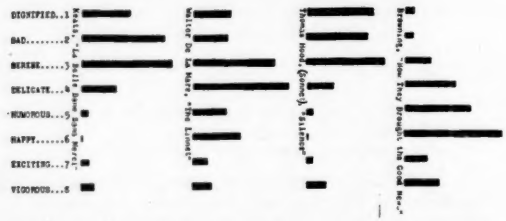



FIG. 2. TOTAL VOTES IN EVERY ADJECTIVAL GROUP FOR THE POEMS

The list of adjectives which the *Os* used was similar to the list used by the experimenter in earlier studies on the affective value of elements in music.[7] The list, which is reproduced below (Fig. 1), contains 64 words arranged around a circle in 8 groups of 8 each, with all the adjectives of similar connotation placed together for the convenience of *O* in finding quickly the best words to indicate his interpretation of the poetry. Every *O* had a fresh copy of the list for each poem.

*Results.* The graph in Fig. 2 represents the results of these expressed opinions on the meaning of these four poems. The eight adjective-groups are represented for convenience along a vertical axis, with the dignified group at the top and the vigorous group at the bottom. On the horizontal axis are represented the total number of votes for all the adjectives in every group.

These graphs first of all show the consistency of the interpretation among the *Os*. Apparently the feeling tone that is associated with certain word sounds and meters is a community experience and readily identified, at least by the college sophomore. The appropriateness of this feeling tone to the meaning or message intended by the poet is particularly striking, it seems to the experimenter. The Keats ballad is pre-

[7] Kate Hevner, Experimental studies of the elements of expression in music, this JOURNAL, 47, 1936, 246-268.

dominantly sentimental, tender, and longing (to choose the adjectives in Group 3 which attracted the most votes); it is also sad, mournful, and melancholy (Group 2) and serious and dignified (Group 1). The votes in Group 4 are concentrated on dreamy and lyrical, and the votes for all the other groups put together make a total of only 15, with eight of these on dramatic and majestic in Group 8.

In contrast to this is the graph for *The Linnet,* where the greatest number of votes fall in Group 4, on lyrical, graceful, and light, and the next highest in Group 3 on serene, soothing, and in Group 6, on cheerful, sprightly, and bright. Hood's sonnet on *Silence* shows almost equal emphasis on sadness, dignity, and serenity, with not a single vote for happiness nor for restlessness and excitement. Browning's poem is more gay and sprightly than anything else, and is also playful and humorous (Group 5) and light, lyrical, and graceful (Group 4). It was not as exciting and restless as might have been expected, but was dramatic and vigorous (Group 8). This last graph in general shows that there was considerable digression from the spirit of Browning's lines, and the two reasons for this 'misinterpretation' might be suggested. (1) Only two stanzas were used, the first and the second, and they may not be typical of the poem as a whole. The second stanza especially with lines full of harsh consonants (notable for their happy humorous effect) as in the line,

"Rebuckled the cheek strap, chained slacker the bit,"

may not have been typical of the whole poem. (2) The choice of anapests in such simple regularity may not have been the best possible choice on the part of the poet as the medium for the expression of this particular mood effect.

These interpretations of the listeners, whether they be considered appropriate or inappropriate to the poetry, must be ascribed solely to the sound effects, to the form, and the versification techniques used by the poet, since these were reproduced faithfully in the translations while the meaningfulness of the words as symbols was omitted. The meter with its characteristic cadences and irregularities, the voice inflection demanded by the poet's word sequences, and the vowel and consonant sounds were the only stimuli of which the *O* could make use.

In considering the question of whether the sound effects when they are married to the words would be more or less effective than they are in these artificial experimental conditions, there is one argument for the affirmative and one for the negative. As we have noted above, the word or phrase that is important for the meaning will also hold the attention for its sound qualities, and the sounds which are lacking in poetic qualities will be ineffectual because unattended to. Thus the sounds and meanings supplement each other at their strongest points and perhaps produce an effect unequalled under the experimental conditions. On the other hand it may be argued that the personal interpretations of the reader expressed through the quality of her voice may have added a helpful suggestion to the listeners which would not lie in the sound of the verses themselves. We cannot claim to have completely eliminated this factor, but both the reader and the experimenter were fully aware of it and adopted a method for dealing with it which seemed to them adequate. By working up the two different readings of each poem, the reader made herself very conscious of every line in the poetry where her own feelings might be exaggerated, and where her own interpretation might be reflected to the best advantage in her voice quality. In choosing the restrained interpretation rather than the more eloquent one, these personal interpretative factors were reduced to a minimum. We do not

mean that a reader may not change quite radically the character of a poem by means of his interpretative effects. The Keats ballad could have been read at a much faster tempo, with larger and more rapid pitch changes, and with more rising inflections, thus making it more light and gay and less sad and sentimental. All of these poems, however, were read in a very simple, neutral, and prosaic manner, with only such modifications of tempo and pitch as the rhythm and the pattern of the word sounds demanded. After all, the lines

"The sedge has withered from the lake,
And no birds sing,"

cannot be made to sound like

"I galloped, Dirck galloped, we galloped all three,"

not even when facial expression, body attitudes and gestures are added to the picture. We believe that even if the reader had attempted to read all the poetry with happy inflections (instead of the neutral ones) there would still have been essential differences in the *degree* of happiness which these four poems could have been made to express. The reader may also be reminded that Sherman's *O*s had great difficulty in identifying the affective tone expressed by an opera singer,[8] succeeding in only 75% of the attempts to express anger and sorrow, and in 50% for fear and pain, and having no success in identifying surprise. We shall also show later that under our own experimental conditions the voice inflection *per se* is not as effective as meter or consonant sounds in conveying meaning to the *O*.

## Main Study

After some further exploratory studies, a method was outlined in which certain elements of poetic sounds could be isolated and varied systematically for experimental work. Since of course no existing poetry could be found and 'translated' for this purpose, it was necessary to write, or rather to construct the poetry expressly to meet the experimental conditions.

*Method and procedure.* The fundamental factor in the construction of poetic sounds, as in the composition of music, is repetition and repetition-with-variation. The pattern, or form, in both poetry and music is nothing more than a pleasing arrangement of recurring sounds. A skeleton structure of repeated accents or congruous tones is filled in with a harmonious complex of sound, with variations of the rhythmic and tonal patterns forming still further interlocking and contrasting patterns, and giving richness, p ace, and variety. In constructing the 'poetry' for these experiments, therefore, we first chose a pattern of repeated sounds which should serve as a model upon which 16 variations could be written. The model had 8 verses, with 5 feet to the verse and an end rhyme scheme of a b a b b c b c, and a simple and obvious pattern of repeated vowel sounds extending through the 8 lines. This vowel sound pattern restricted the sounds appearing on the accented syllables to three, and arranged them in a sequence which completed itself in the first four lines followed by a second slightly different pattern in the next quatrain.

[8] Mandel Sherman, The emotional character of the singing voice, *J. Exper. Psychol.*, 11, 1928, 495-497.

For example, in the stanza which used only the dark, full rounded, back-of-the-mouth vowels **oo**, å, and ō, the two quatrain patterns were as follows.

| | | | | |
|---|---|---|---|---|
| **oo** | å | ō | å | **oo** |
| **oo** | å | **oo** | å | å |
| ō | å | ō | å | **oo** |
| ō | **oo** | ō | **oo** | å |
| ō | **oo** | ō | **oo** | å |
| **oo** | å | **oo** | å | ō |
| ō | å | **oo** | å | å |
| **oo** | å | ō | ō | ō |

The stanzas which made use of only the light, open, thin, front vowels, **ee**, ī, and ā sounds, followed the same pattern of repetitions substituting **ee** for **oo**, ī for å and ā for ō. These two groups of vowel sounds were chosen for contrast because they seemed to be at the opposite ends of the scale with respect to ease and character of the movements made in producing them, and with respect to the pitch, overtones, and vocal qualities in general, and because therefore they should offer the best chance of discovering a difference in the search for affective values of vowel sounds. The unaccented syllables were filled in with the short vowel sounds, especially ĕ as in met, ĭ as in sit, ă as in sat, ŭ as in up, and ŏ as in hop. There was no particular pattern or repetitions of them except in the enrichment of end rhyme. For the iambic verses, one short syllable was inserted before each accented syllable and for the anapests two were inserted.

Of the consonant sounds, the two different combinations chosen for study might be classified as smooth and harsh. The smooth consonants included l, m, n, r, ng, and combinations of these with d, p, th, b, v, s, f, etc., such as ld, dr, pr, pl, fr, nd, rm, rl, etc. The harsh sounds were the hard g, k, t, ch, tch, tz, and combinations such as rk, tr, nch, kr, rch, etc. It would not be possible to say that the consonants were divided in any particular way between accented and unaccented syllables, but only that they served to stop and to connect vowel sounds and to differentiate the syllables. The syllables that received particular emphasis, such as the end rhyme and internal rhyme, always carried, however, a harsh or a smooth sound unmixed with any mitigating effects of the opposite kind.

In distributing these consonants through the verses no strict scheme or pattern was followed. The guiding principles were subjective ones: (1) the pleasing effect of the sounds; and (2) their similarity to actual language sounds. It was in order to satisfy this second condition that the occasional hard or harsh sounds were introduced into the smooth consonant stanzas, for without them the poetry sounded artificial and nonsensical. Likewise an even larger proportion of smooth and soft sounds was necessary in the harsh consonant stanzas, for without them the lines were again ridiculous and unconvincing. The pleasing effect of the sounds was judged by several students from the English and Speech departments of the University, who read or chanted the verses aloud and offered suggestions and criticisms.

The reactions of the *Os* to the poetry were always extremely favorable. There were never any objections to the task of listening and no indications that the verses were heard as mere nonsense. On the contrary the five most frequently marked adjectives in the check list were serious, earnest, dramatic, emphatic, and dignified.

Four stanzas of poetry were made by combining the consonant and vowel sounds

as follows: smooth consonants and round back vowels, smooth consonants and light front vowels, harsh consonants and full back vowels, and harsh consonants and light front vowels. Two versions are here quoted.

Pŏ droom lĕn ăld lĕr mōn dĕn zăng ĕnd loon
Mĭ thoor dĕl pâr dŏng ploom ĕn brâth lĭng mârl
Bă lōl drĕn thâr kĕd frōling vâr sŭn doon
Dăth ă vōl mĕn roo klĕn pōl dĕr woov frĕ dârl
Vŏnd lō nĕn roo thĭr lō vrĕn kloon ĕn dâng
Thră moo frŏ lâ fră doothĭng kâm ĕn grōl
Dăn hōd lă mâ vĕn doom ĕd lâ vĕr zâng
Mĕrd loo văn dârd ĕl ă mō thĭ ĕr lōn fră dōl

Dă kooch lĕn dâtz ĭng grōtz trăp lânch dĕl krooj
Pĕr dooz brĕnk strâf ĕr dooz ĕn châg prĕn grâk
Tĕr zōl drĕn kách ĕrl fōj ĕs trâk zĕn frooj
Dōn nă jōth ĕs koop dĕs pōlk rĕn vood rĕs trâk
Chă kōl dĕr drook chăn vōld rĕ râk lă krâg
Hăl kroog ĕd hâz dĕn grook lĕd stâg rĕn strōsk
Tĭ stōk nĕn châb rĭl toog rĕn stōk nĕn vrâg
Eks droog hĕl vâd ĭ kĕth stō krĕd tōn drĕn thrōsk

These four versions were written originally in iambic pentameter with a few irregularities such as would be found in a stanza of bona fide poetry. These same four versions were then rewritten in anapests by separating the one accented syllable into two short syllables. This introduced a third beat to each measure without changing the consonant sounds in any way, and without changing the vowel sounds in any noticeable or significant way. The first line of the smooth consonant-round vowel version in both iambs and anapests will give the reader a notion of the method.

Pŏ dróom lĕn ăld lĕr mōn dĕn zăng ĕnd lóon
Pĭ ŏ dróom ĕl ĕn ăld lĭ ĕr mō ĕndĕn zăng ĕn ăd lóon.

There were then eight different stanzas representing all the possible combinations of the three variables, vowels, consonants and meter. The fourth variable, the voice inflection, was introduced to solve the problem of reading the verses so that they should sound as much as possible like true poetry, and so that the same pattern of pitch, emphasis, and pause could be maintained throughout the eight versions. Two sonnets by Wordsworth were chosen as models for the pattern of voice inflection, *"Milton, Thou Shouldst Be Living at This Hour!"* and *"The World Is Too Much with Us, Late and Soon."* The first eight lines of the sonnet to Milton were written out and the reader practiced them until a satisfactory interpretation was developed and outlined on the copy. Then underneath each line of the sonnet, which still served as a guide, the corresponding line of the experimental poetry was copied and the reader used the same voice pattern for reading both. After much practice, the reader learned this pattern just as if it were a tune for a song, and was able to read the anapest versions to the same 'tune' with little difficulty and practically no changes in the pattern. When the reading had been perfected to the experimenter's satisfaction, the eight versions of the poem were recorded on phonograph disks and the second pattern, following the second sonnet was applied to the same eight versions and eventually recorded on the phonograph disks.[9]

[9] Without the particularly intelligent and earnest work of Miss Evelyn Steele and Mr. Arthur Peterson, professional actors, this part of the study would not have been successful.

These sixteen versions of the poetry were then presented to groups of *Os* who were asked to report on its meaning. The same conditions were maintained as for the earlier experimental work with the 'translated' poems. The groups were laboratory classes in psychology, sophisticated in procedures of this sort. The preliminary directions were the same. The students recorded their interpretations for each stanza after they had listened to it twice, by checking the adjectives from the prepared list. Four different stanzas were heard by each of four different class groups numbering from 36 to 42 students. They had a 4-min. rest period between each poem, during which there was discussion of general laboratory problems. Several months after the first presentation of the material a second trial was arranged with a similar group of laboratory students. In this second experiment the same group heard all 16 records, 2 at the beginning of a 2-hr. period, and 2 at the end of the period, for 4 successive class days during a given week. Since the results of the two experiments carried on under these slightly different conditions produced no essential differences in the results, the data for all groups are combined in the present account.

The phonograph recordings were made on wax disks, by the same reader at various times. Two records were made of each stanza and the better of the two was selected for the experiments. Although every attempt was made to read each version at the same tempo, pitch, and loudness, there were some slight differences. The degree of loudness for each stanza was measured in decibels and there was a variation of from 9 to 13 db. among the sixteen stanzas. Although these differences constitute a source of error, it is unlikely that they vitiated the results of the experiment in any consistent way. When all other factors—vowels, consonants, meter, and inflection are held constant and four loud records with an average of 12.5 db. were contrasted with four soft records with an average of 9.25 db., no significant differences were found on any adjective group. The ratios of the differences to their probable errors were 1.7, 3.2, 2.3, 1.2, 2.3, 0.7, 2.1, and 0.3, for adjective groups 1 to 8 respectively. Variations in tempo were very small; for stanzas with the 2-syllable foot the reading time varied from 25 to 28 sec., and for the 3-syllable foot, from 28.4 to 31 sec. Variation in pitch was difficult to evaluate but was estimated as negligible.

*Results.* In assembling the data from these studies, the votes for all the *Os* for one experimental stanza were tabulated, and further combined by adding together the votes for all eight of the words which constituted one adjective group. This method offered a convenient summary of the characteristics of any one poem in order to make comparisons with the characteristics of any other stanza. With very few exceptions these characteristics were clear-cut and consistent, showing that the *Os* found some affective value in the poetry quite readily and that they tended to agree with one another in their interpretations.

In order to make more important comparisons such as the relative effect of the 2- and the 3-syllable foot, the votes for all eight versions with the iambic meter were added as were those for the eight versions of the anapests, and the differences were calculated for each adjective group. In this way all the factors except the meter remain constant, and any differences thereby discovered in the interpretations of the *Os* must be attributed to

the effects of the two different meters. Table I presents the data not only for the 2- and the 3-syllable foot, but also for the harsh and the smooth consonants, the full and the high thin vowels, and the two patterns of voice inflection. The table gives not only the total votes, but also the difference between the votes for the contrasted elements, divided by the probable error of this difference. These differences are calculated in terms of the percentage

TABLE I

SHOWING, FOR 620 *Os* UNDER THE DIFFERENT EXPERIMENTAL CONDITIONS, THE TOTAL NUMBER OF VOTES AND THE RATIOS OF THE DIFFERENCES TO THEIR PROBABLE ERRORS

| | Total number of votes | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | meter | | | consonants | | | vowels | | | inflection | | |
| Adj. group | 2-syl.foot | 3-syl.foot | D/P.E.$_D$ | harsh | smooth | D/P.E.$_D$ | full | high | D/P.E.$_D$ | pat. 1 | pat. 2 | D/P.E.$_D$ |
| 1. Dignified | 635 | 349 | 13.8 | 486 | 498 | 0.8 | 539 | 445 | 4.3 | 575 | 409 | 8.0 |
| 2. Sad | 190 | 99 | 7.4 | 185 | 104 | 6.5 | 132 | 157 | 1.7 | 195 | 94 | 8.1 |
| 3. Serene | 236 | 157 | 6.4 | 148 | 245 | 7.1 | 154 | 239 | 6.1 | 209 | 184 | 1.8 |
| 4. Delicate | 246 | 294 | 3.4 | 253 | 287 | 2.3 | 202 | 338 | 8.3 | 270 | 270 | 0.0 |
| 5. Playful | 249 | 482 | 14.1 | 455 | 277 | 9.8 | 378 | 354 | 1.3 | 317 | 415 | 5.5 |
| 6. Happy | 278 | 462 | 10.2 | 436 | 304 | 8.1 | 348 | 392 | 2.4 | 315 | 425 | 6.0 |
| 7. Exciting | 173 | 300 | 7.7 | 229 | 244 | 1.1 | 258 | 215 | 2.7 | 239 | 235 | 0.3 |
| 8. Vigorous | 389 | 339 | 2.7 | 319 | 409 | 6.0 | 409 | 319 | 5.5 | 415 | 313 | 5.7 |

of total possible votes in any adjective group. Since there were 620 *Os* and 8 adjectives in each group, the total possible votes were 4960. The percentage in Group 1 would be 0.128 and 0.07 for the 2- and 3-syllable meters respectively. This difference has a probable error of 0.0042, when calculated by the formula $P.E._D = [P.E._1{}^2 — P.E._2{}^2]^{1/2}$ and the Paterson-Edgerton tables,[10] and the ratio of the difference to its probable error is 13.8. Since this method is probably the most valid one for estimating the significance of the differences appearing in the table, the ratios have been calculated and inserted in the table for all four of the variables. Fig. 3 is designed to show the relative effect of these variables in more easily comprehensible terms. The figure is constructed from the data in columns 4, 7, 10, and 13 respectively. The groups are posed around the circumference of a circle and the key shows the character of the adjectives in each group. It is readily apparent from this figure that the meter has the greatest effect of any of the four factors and the consonant sounds the next largest effects.

It is also apparent when comparing the four circles that the variables are effective in quite different areas of feeling tone. Meter, for example, it not

[10] H. A. Edgerton and D. G. Paterson, Table of standard errors and probable errors of percentages for varying number of cases, *J. Appl. Psychol.*, 10, 1926, 378-391.

useful in discriminating forcefulness from grace, but vowel sounds are most useful on this diameter of the feeling circle; meter is very effective in determining the happiness or sadness of the poetry, while vowel sounds are quite ineffectual in this capacity. The 3-syllable meter is most of all effective in lending the poetry its playful, sparkling, humorous, qualities, its

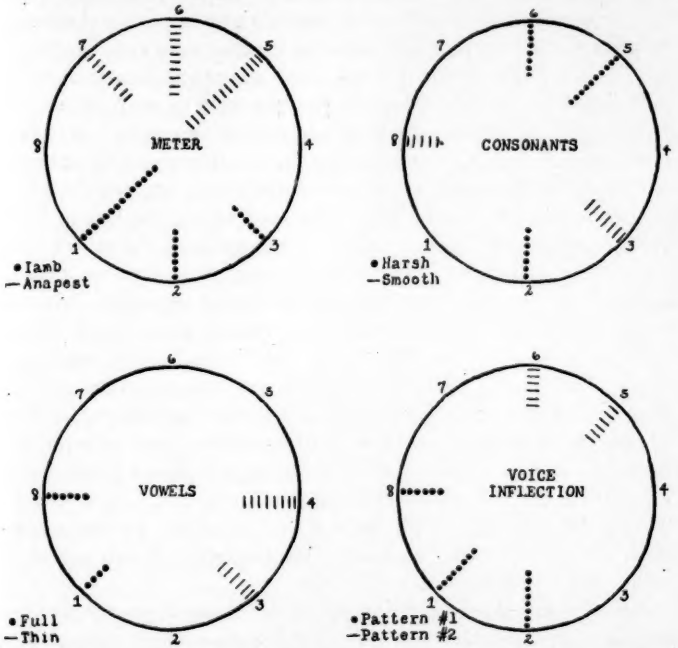



FIG. 3. RELATIVE EFFECTS OF THE FOUR VARIABLES ON THE AFFECTIVE TONE OF THE POETRY

Significant differences ($D/P.E._D > 4$) are represented for each adjective group. Adjectival groups: (1) dignified, serious; (2) sad, mournful; (3) sentimental, calm; (4) delicate, light; (5) humorous, sparkling; (6) bright, happy; (7) exciting, spirited; and (8) vigorous, emphatic.

happiness and brightness and its impetuous, elated, restless feeling. The 2-syllable foot is sharply and consistently contrasted with these clusters of feelings and lends especially dignity and earnestness, sadness, tenderness, and serenity. The ratios of the differences to their probable errors were also calculated for each of the 64 adjectives separately, and those found to be most significant for the anapests were *jovial, joyous, humorous, merry,*

*sparkling, light, gay, spirited, sprightly, impetuous, playful,* and *bright.* For the iambic meter the significant adjectives were *solemn, serious, earnest, sober, ponderous, sad, grave, majestic, heavy,* and *dignified.*

The contrast between the smooth and harsh consonants is less marked than the effect of the meter, although this may be due partly to certain limiting conditions which developed when the poetry was being composed. The iambic pentameter was varied occasionally with anapests and spondees, and the verses written in anapests likewise included some variations because an absolute regularity in meter would sound absurd and unpoetical. Nevertheless there was a contrast between the two rhythms much sharper than could be achieved between the harsh and smooth consonants—an isolation of the metric variable that was not possible to achieve with the consonant variable. When the first stanza of poetry was written out, only the smooth consonants were used in its construction, and although it had an insipid and monotonous and halting sound, it was not until the second stanza was devised, employing only the harsh consonants, that the exclusive separation of the two groups of consonants proved impossible. The verses written with harsh consonants only were artificial and strained. To read them was a physical impossibility; they had no dignity, they were suggestive of stuttering and other speech defects and were unpleasant as well as absurd. They were not convincing as language and certainly not as poetry. The author therefore experimented with the verses using with the harsh consonants more and more l, m, ng, r, sounds to achieve a convincing language effect, and with the smooth consonants more p, d, k, z, sounds until the artificial effect was entirely removed. A study of the two stanzas quoted above will give the reader a notion of the proportion of each type of consonant in the two versions.

Rigid limitations for the two groups of vowel sounds was not attempted, because of the artificial effects which would have resulted, although in the case of these sounds, all accented syllables carried the experimental sounds exclusively and the unaccented syllables carried only the short and neutral vowel sounds. These conditions do not therefore fulfill the criteria necessary for complete experimental isolation of the variable, but they do conform to the conditions which obtain everywhere in the usage of these factors for poetic effects. The conclusions drawn from these experiments should therefore define the rôle that these factors play in the total effect of poetry, with greater exactitude than might be expected if the experiment had been conducted under more strictly controlled but more artificial conditions.

The harsh consonant sounds are primarily humorous, *sparkling,* and *playful,* and also *cheerful* and *gay.* The amazing thing is that they are likewise responsible for giving the poetry its heaviness and gloom. This serious

inconsistency may be due to the fact that the particular groups of consonants chosen for study included two (or more) kinds of sounds, one of which produced the happy effect, the other the sad. It might also be due to two well defined attitudes which these harsh sounds provoked: if the listener attended to the actual sounds, they might produce a gay or humorous effect, whereas if he were following the poetry from the speaker's point of view, the effort and strain in producing these lines with the human voice might bring about the affective tone of heaviness and sadness. When the significance of each word in the sad group was calculated, the two important words are *heavy* and *gloomy*. The other significant words for describing the harsh sound effects were *sprightly, merry, jovial, humorous, quaint, carefree,* and *sparkling*. The adjectives characteristic of the smooth consonants were, in order, *soothing, spiritual, dreamy, vigorous, lyrical, exalting, earnest, romantic,* and *gentle.*

The contrasting groups of vowel sounds, the rounded **oo**, ȧ, and ō and the **ee**, ī, and ā show smaller differences, and over a very limited area of the affected field. The full round back vowels are more *dignified, emphatic,* and *serious;* the high front thin **ee**, ī, and ā are *light* and *leisurely, serene* and *romantic*. Only four words in the whole list of 64 had differences which satisfied the usual criterion that a difference must be four times its probable error, and this fact together with the barely satisfactory differences shown on the chart when the adjectives are treated in groups, points to the conclusion that the effects due to the vowel sounds are less stable than those due to meter and to consonant sounds. This instability may be due however to a poor selection on the part of the experimeter of the vowel sounds to be contrasted. It is possible that some other sounds, especially groups known to have a large difference in the pleasantness and unpleasantness of their sounds,[11] might yield more pretentious effects.

The two patterns for the voice inflection, the two Wordsworth sonnets, *Milton, Thou Shouldst Be Living at This Hour!,* and *The World Is Too Much with Us,* were not different from each other in any consistent way, although the first with its apostrophe at the beginning and its forceful closing line (for our stanza) "And give us manners, virtue, freedom, power," tempted the reader to a more eloquent and dramatic interpretation than the more staid and gentle lines of the second. The chart for the voice inflection shows slightly more stable effects than for the vowels and the study of the differences on individual adjectives emphasizes the same effects. There are nine words that yield significant differences for the sonnet on Milton; they are, in order, *heavy, mournful, serious, solemn, dramatic, dreamy, sad,*

[11] Roblee and Washburn, *op. cit.*

*ponderous* and *forceful.* The second sonnet has five distinguishing adjectives, *carefree, playful, quaint, sprightly* and *bright.*


## Summary

Nonsense poetry was written by the author for these experiments in order to arrange for a systematic variation of four elements: meter, voice inflection, vowel, and consonant sounds. A model stanza of eight lines was chosen, with five feet to the line, and an end rhyme scheme of a b a b b c b c, and with repetitions of vowel and consonant sounds to simulate internal rhyme, alliteration, cadences, etc. Sixteen versions of this model poem were written. In Model 1, for example, the meter was iambic, the accented syllables contained only the round back vowel sounds, **oo**, â, and ō, and only smooth liquid consonant sounds, m, n, l, r, etc., and the pattern of the voice inflection followed a set pattern. Model 16 had an anapestic meter, the thin, front vowel sounds, **ee**, ī, and ā, harsh consonant sounds, ch, k, gr, tz, etc., and was read with a different inflection pattern. The other fourteen models presented different combinations of these variables.

The poetry was recorded on phonograph disks and presented to 620 listeners in groups of 36 to 42 and the *O*s reported the 'meaning' by checking adjectives from a prepared list.

Results show that the 2-syllable foot is solemn, earnest, dignified, and sad, in contrast to the 3-syllable foot, which is joyous, light, sparkling, spirited, and gay. Harsh consonants are sprightly, merry, jovial, and quaint, and paradoxically they also give the poetry its heaviness and gloom; while the smooth consonants are soothing, spiritual, dreamy, lyrical, and exalting. The full rounded vowels are the more dignified, emphatic, and serious, while the thin front sounds are more light, leisurely, serene, and romantic. The two-voice patterns also show some differences, for the one tends to be dignified and solemn and the other somewhat light and fanciful.

In the order of their effectiveness the factors are: (1) meter, which is distinctly stronger than the others; (2) consonant sounds; (3) voice inflection; and (4) vowel sounds. These relative effects are probably typical of the rôle played by these factors in poetic form in general, because of the fact that in setting up the experiments we have been careful to duplicate the treatment of these variables in bona fide poetry rather than to meet the requirements of complete experimental isolation.

Translations of four short poems into meaningless verses which retain all the metric effects, vowel and consonant sounds and voice melody of the original, show agreement in interpretations from groups of listeners and affective tone which is strikingly appropriate to the expressed meaning of the poet.

# THE GENUINENESS OF HYPNOTICALLY PRODUCED ANESTHESIA OF THE SKIN

By FRANK A. PATTIE, JR., The Rice Institute

How 'real' or 'genuine' are the anesthesias produced by hypnotic suggestion? Many recent authorities believe that such anesthesias are genuine, *i.e.* that they show all the characteristics of organic anesthesias except, of course, that they are produced and removed by suggestion.

For example, McDougall explicitly states his opinion that these anesthesias are genuine and involve an actual interruption of functional continuity of neurones.[1] Most other writers simply state that anesthesias of the sense-organs can be produced in the hypnotic trance and leave the matter there without any neurological or other theory and without any questioning of their genuineness.[2] On the other hand, there has been lately expressed a considerable amount of skepticism on this subject. Dorcus and Shaffer recognize the existence of the problem of the nature of anesthesia, saying, "whether pain is felt to any degree when anesthesia is suggested is a question still not satisfactorily answered. . . . The arm or hand of a hypnotized subject can be burned or cut without any observable signs. Nevertheless, there is a sensation of pain, since if the subject is re-hypnotized and told to recall his experiences, he will state that pain was experienced."[3] It cannot be said that these authors arrive at any conclusions on this subject. Hull, in his recent work,[4] shows an attitude of healthy skepticism but seems not to go, so far as a general theory is concerned, beyond the conclusions reached by his former student Sears in his study of hypnotic analgesia, which is discussed below.

Indeed, we can hardly blame these authors for not developing any general conception of hypnotic anesthesia, since up to the present not much experimentation has been reported. Bechterew,[5] in a short article, states that, when analgesia of the skin is produced, stimulation by pricking fails to elicit the normal respiratory, cardiac, and pupillary reactions. He gives several Russian references, which presumably contain the data upon which his conclusions are based. It is well established that the galvanic skin reflex occurs when hypnotically anesthetized receptors are stimulated.[6]

---

* Accepted for publication, June 15, 1936. The substance of this paper was presented at the meeting of the Southern Society for Philosophy and Psychology at Atlanta in April, 1936. The writer wishes to express his gratitude here to a former student, Miss Katherine Dionne, who served as a volunteer assistant in the work on normal *Ss*.

[1] W. McDougall, *Outline of Abnormal Psychology*, 1926, 89.

[2] For example, H. Banister, *Psychology and Health*, 1935, 127; E. S. Conklin, *Principles of Abnormal Psychology*, 1935, 333.

[3] R. M. Dorcus and G. W. Shaffer, *Textbook of Abnormal Psychology*, 1934, 190.

[4] C. L. Hull, *Hypnosis and Suggestibility*, 1933, 250-270. Pp. 256-267 summarize the experiment of Sears.

[5] M. W. de Bechterew, Des signes objectifs de la suggestion pendant le sommeil hypnotique, *Arch. de Psychol.*, 5, 1905, 103-107.

[6] M. Levine, Psychogalvanic reaction to painful stimuli in hypnotic and hysterical anesthesia, *Bull. Johns Hopkins Hosp.*, 46, 1930, 331-339; J. B. Dynes, An experi-

Sears says that its magnitude is reduced by about 20% when painful stimulation is applied; Dynes says that there is a "slight decrease." The others give no quantitative data.

Dynes studied the effect of hypnotic analgesia and deafness on respiratory and cardiac reactions occurring after strong stimulation. He found that suggestions of anesthesia result practically in an abolition of the respiratory and cardiac changes which normally occur after a pistol shot or after a painful sharp stimulus is applied to the skin. Sears performed a similar experiment but restricted his observations to the comparison of the physiological changes occurring when the two legs of a *S* are painfully stimulated, when one leg has been made analgesic. The physiological changes most susceptible to voluntary control were most reduced; the facial flinch and the increase in respiratory oscillation and variability were practically eliminated. Pulse oscillation and pulse variability were reduced 77% and 50%, respectively. Hull connects this relative non-modifiability of the cardiac reactions to the fact that these reactions are not under voluntary control. Dynes states that no changes in the normal cardiac "rate and rhythm" occur after stimulation of the anesthetized sense-organs; but, since he did not apply to his records the refined measurements of "oscillation" and "variability" developed by Hull and used by Sears, it is possible that there would be no such great difference between Sears and Dynes on this point if both sets of data were treated in the same way. Sears concluded from certain control experiments, in which the *S*s were directed to simulate an anesthesia (in the normal state, however, not while in the trance), "that hypnotic anesthesia is in any sense a conscious simulation seems doubtful. Voluntary inhibition of reaction to pain does not present a picture even remotely resembling the reaction under true hypnotic anesthesia." Dynes likewise found that his *S*s could not inhibit the cardiac and respiratory reactions to pain and to the sound of the pistol.

The present writer attempted to produce uniocular blindness by hypnotic suggestion in 5 *S*s, but in no case was he successful.[7] He was deceived by one very clever *S*, who faked certain visual tests in such a way as to give the appearance that one eye was actually blind. For a long time he believed that a genuine blindness had been produced in this *S*, but finally he contrived a complicated filter-test which showed that the *S* was not blind. In the report of this work the methods used by the *S* in faking the tests have been discussed, and a considerable amount of evidence has been presented to show that the conative tendencies which led the *S* to simulate blindness were dissociated from her principal integrate of personality, and that she actually believed that she was blind in one eye, even when she was doing all she could to pass the tests, either by utilizing her knowledge of vision or by furtively disobeying instructions. Another *S* simulated blindness, but he was easily detected by the tests.

A complete history of this problem should include a reference to the work of Lundholm,[8] although his experiments are not altogether relevant to the work here

---

mental study in hypnotic anesthesia, *J. Abnor. & Soc. Psychol.*, 27, 1932, 79-88; R. R. Sears, An experimental study of hypnotic anesthesia, *J. Exper. Psychol.*, 15, 1932, 1-22; Dorcus and Shaffer, *op. cit.*, 94-96.

[7] F. A. Pattie, Jr., A report of attempts to produce uniocular blindness by hypnotic suggestion, *Brit. J. Med. Psychol.*, 15, 1935, 230-241.

[8] H. Lundholm, An experimental study of functional anesthesias as induced by suggestion in hypnosis, *J. Abnor. & Soc. Psychol.*, 23, 1929, 337-355.

reported. He produced anesthesias in the post-hypnotic period and for particular impressions; they were not anesthesias involving all impressions from a given sense-organ.

## The Experiment

The experiment reported here is so simple that it could have been performed just as well a hundred years ago, when the French Academy of Medicine appointed a committee (which reported negatively) to investigate the alleged anesthesias produced by the magnetist Berna.[9] The experiment starts from this fact. If a person clasps his hands in the position of the 'Japanese illusion' and tries to count the number of times he is touched on one hand (the right or the left as specified in advance), while the fingers of both hands receive in the same short period of time several touches, he can seldom report correctly.

To put the hands in the position of the Japanese illusion, extend the arms with the backs of the hands together and the thumbs pointing downward. Now cross the wrists, still keeping thumbs down, interlace the fingers, and clasp the hands. Now bring the hands toward the chin by flexing the elbows, then bring the elbows down until they touch the sides of the body, at the same time rotating the clasped hands through about 270° until the thumbs point upward.[10]

If a functional anesthesia produced in one hand by hypnotic suggestion behaves like an organic anesthesia, it should make no difference whether the *S*'s hands are put into this position of confusion or not; with the hands clasped in this position he should be able to count correctly the number of touches received by the 'good' hand, no matter whether or how many times the 'anesthetic' hand is stimulated. If, however, the anesthesia behaves as if simulated, the *S* should give a great many erroneous reports on the number of touches felt on the 'good' hand, just as does the normal person when put into this situation.

*Normal.* Before the ability of the hypnotic *S* can be studied, it is necessary to investigate the extent of the normal *S*'s ability to count the touches on one hand when both, in the confusion-position, are being touched.

Fifteen normal *S*s, university students, were tested. All but *D* and *O* were men. The instructions given, after the hands had been put into position, were:

Close your eyes. You will be touched on the fingers of both hands. Count the number of times you are touched on the fingers of the left hand. No finger will be touched twice in succession. Do not estimate the number, but count as well as you can.

---

[9] A. Binet and C. Féré, *Animal Magnetism*, 1888. Cited by Hull, *op. cit.*, 251.

[10] Drawings of the steps to be followed in taking this position are found in C. van Riper, An experimental study of the Japanese illusion, this JOURNAL, 47, 1935, 252-263. Van Riper in this paper deals with the effect of this position on the *S*'s ability to move his fingers when they are supplied with numbers and *E* calls out the number of the finger to be moved.

The *S*'s thumbs were never touched. No report was ever made to the *S* as to the nature or the extent of his errors.

The touches were delivered by the *E*, who touched the fingers of the left hand, and an assistant, who touched the fingers of the right hand. The stimulators were pieces of rubber taken from ordinary large rubber erasers and had dimensions of 1.5 x 0.5 (the surface applied to the skin) x 2 cm. They were attached to thin strips of brass (11 x 1.5 x 0.03 cm.), which in turn were fastened to wooden sticks of a size convenient for the hand. The brass strips projected over the end of the wooden stick 3.5 cm. A wire fixed above the brass strip marked the amount of bending of the strip necessary to produce a pressure of 75 grm. Care was taken to insure that the *E*'s and the assistant's touches were equally intense. The *E*'s touches were applied at a variable rate, which did not exceed 2 per sec. A stop-watch was used to time the touches so that the maximum rate might not be exceeded. The touches on the hand selected for counting should not be delivered faster than the *S* can count them; a fair check on the rate was afforded by the fact that the *E* himself had to count the touches as he delivered them. The assistant's rate did not have to be strictly controlled, as the *S* did not have to count the touches, but it is believed that the rate rarely, if ever, exceeded 2 per sec.

Ten series of touches were applied to each *S*. Each series consisted of 20 sets of stimulations ranging in number from 11 to 30 applications on the critical hand. The order of these 20 stimulations was determined by chance (numbered cards were used and shuffled before each series was made up). Five series were given in the first hour of experimenting, and 5 in the second hour, which came after two or three days. To be sure that the *S* knew what he was to do, he was first given 11 or 12 touches on the left hand, while the assistant also was touching him. His report on this first stimulation was not recorded.

*S*s were scored thus. The errors made in each of the 20 reports in a series were added without regard to sign (*e.g.* the error was 4 if the *S* called 11 touches either 7 or 15). The record for each *S* presented in Table I consists of a set of 10 numbers representing the sum of errors in each series. If the *S* said that he lost count, the particular number on which he lost count was repeated at the end of the series. Losing count was infrequent.

These results, given in Table I, show large individual differences and great variation, due no doubt to the fact that many factors influence the *S*'s report, such as the number of times the assistant stimulates, and the rate of stimulation. A greater refinement of the method, to control more factors, would no doubt reduce the variation somewhat but would probably not eliminate it wholly. The bottom row of the table shows the mean number of errors made by the 15 *S*s in the 10 series. It shows that, taken as a group, the *S*s showed a considerable improvement in their ability, even though they had no knowledge of the correctness of their reports.

TABLE I

TOTAL ERRORS OF NORMAL *Ss* IN DISTINGUISHING BETWEEN TOUCHES ON THE TWO HANDS WHEN THE HANDS ARE IN THE CONFUSION-POSITION

| *Ss* | Series | | | | | | | | | | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| *A* | 65 | 16 | 23 | 12 | 9 | 4 | 10 | 3 | 4 | 5 | 151 |
| *B* | 65 | 62 | 31 | 34 | 28 | 34 | 19 | 22 | 16 | 9 | 320 |
| *C* | 52 | 43 | 47 | 49 | 53 | 45 | 23 | 43 | 39 | 30 | 424 |
| *D* | 110 | 49 | 43 | 37 | 28 | 17 | 21 | 23 | 16 | 26 | 370 |
| *E* | 38 | 13 | 6 | 9 | 7 | 4 | 3 | 16 | 3 | 0 | 99 |
| *F* | 69 | 45 | 36 | 12 | 24 | 8 | 8 | 4 | 2 | 7 | 215 |
| *G* | 61 | 61 | 38 | 72 | 55 | 67 | 66 | 46 | 55 | 63 | 584 |
| *H* | 32 | 16 | 33 | 38 | 31 | 28 | 46 | 39 | 87 | 84 | 434 |
| *I* | 111 | 52 | 37 | 41 | 53 | 27 | 13 | 7 | 4 | 7 | 352 |
| *J* | 177 | 137 | 149 | 88 | 138 | 118 | 84 | 44 | 102 | 67 | 1104 |
| *K* | 40 | 60 | 41 | 23 | 18 | 6 | 4 | 5 | 3 | 3 | 203 |
| *L* | 79 | 48 | 26 | 45 | 42 | 32 | 45 | 43 | 45 | 52 | 457 |
| *M* | 60 | 65 | 58 | 19 | 10 | 6 | 17 | 2 | 3 | 5 | 245 |
| *N* | 99 | 69 | 65 | 51 | 39 | 65 | 92 | 94 | 42 | 59 | 675 |
| *O* | 43 | 28 | 25 | 27 | 45 | 24 | 30 | 26 | 23 | 20 | 282 |
| Av. | 73 | 51 | 44 | 37 | 39 | 32 | 32 | 28 | 30 | 29 | 394 |

*Hypnotized.* Five hypnotic *Ss* (all men), including 3 university students and 2 graduates (not students), were used. All the *Ss* were very good somnambulists and had complete amnesia for events of the trance. None had knowledge of the nature of the experiment. Of course it is likely that the *Ss* could infer its nature while acting as *Ss*. In order to protect himself from fakers (whom he has sometimes encountered in experimental work) *E* had each *S* sign a statement as follows: "I, realizing that the experiment performed on me will probably be published in a scientific journal, solemnly declare that I was not faking or imitating the hypnotic trance but that I was genuinely hypnotized and do not remember the events of the experimental periods."

The procedure used with the hypnotized *S* was as follows. An anesthesia of the right hand and arm was suggested, and his sensitivity was tested by pinching, pressing, and pricking his hand. If he declared that he sensed nothing, he was then blindfolded by tying a thick newspaper around his head. (After experiences with malingering in the experiment on hypnotic blindness already cited, no chances were taken with the ordinary bandage-blindfold.) The *S*'s hands were then put into the position of the Japanese illusion, and the following instructions were given:

You can feel nothing with your right hand. You will now receive a number of touches, and since you can feel nothing with your right hand, they will be felt only on the fingers of the left hand. Count the touches received by the fingers of your left and and report the number as soon as they cease. No finger will be touched twice in succession. Do not estimate, but count as well as you can.

From this point on the procedure was exactly the same as that followed in the case of the normal *Ss*, except that the sensitivity of the hand was tested once or twice in every series.

TABLE II

TOTAL ERRORS OF HYPNOTIZED *Ss* IN COUNTING TOUCHES ON A SENSITIVE HAND AND IGNORING IMPRESSIONS ON AN ANESTHETIZED HAND WHEN THE HANDS ARE IN THE CONFUSION-POSITION

| *Ss* | Series | | | | | | | | | | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| *P* | 93 | 70 | 83 | 47 | 84 | 57 | 45 | 35 | 37 | 45 | 496 |
| *Q* | 36 | 14 | 35 | 26 | 37 | 24 | 24 | 24 | 35 | 23 | 278 |
| *R* | 18 | 7 | 9 | 31 | 13 | 4 | 7 | 16 | 9 | 4 | 118 |
| *T* | 33 | 42 | 40 | 37 | 69 | 35 | 22 | 12 | 30 | 25 | 345 |
| *U* | 38 | 46 | 68 | 79 | 55 | 38 | 60 | 40 | 75 | 60 | 559 |
| Av. | 44 | 36 | 47 | 44 | 52 | 32 | 32 | 25 | 37 | 31 | 359 |

Table II shows the results of the work on hypnotized *Ss*.

*Comparison of the normal and hypnotized.* A comparison of the data in the two tables shows that there is no reason for claiming that the hypnotic *Ss* can perform this task better than the normal *Ss*. The mean total number of errors made in the 20 series by the normal *Ss* is 394. Three of the hypnotic *Ss* made fewer errors, three made more than this number. The average numbers of errors in each of the 10 series, placed side by side for comparison, are as follows:

| *Ss* | Series | | | | | | | | | | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| Normal | 73 | 51 | 44 | 37 | 39 | 32 | 32 | 28 | 30 | 29 | 394 |
| Hypnotized | 44 | 36 | 47 | 44 | 52 | 32 | 32 | 25 | 37 | 31 | 359 |

The hypnotic *Ss* are superior to the normal in the first and second series but inferior in the fifth and equal, or nearly equal, in the remaining series. If we neglect the first two series, the degree of improvement in the task is about the same for both kinds of *Ss*. From this comparison it may be concluded that the suggestion of anesthesia in the right hand does not affect the ability of the hypnotized *Ss* to count the number of touches received by the left hand when the hands are in the confusion-position. The differences between the two groups in the first and second series, if significant, must be explained as due to greater concentration on the part of the hypnotized *Ss* or some similar cause. If we attempt to explain this superiority as due to the suggestion of anesthesia, we can find no reason why this superiority should not have persisted through the remaining series.

*Qualitative observations.* In a large number of cases the hypnotized *Ss* reported a number which was less, in some cases considerably less, than the number of touches applied to the left hand. In a number of cases when there was a considerable difference between the numbers of touches applied

by the *E* and the assistant, the *S* would report the number applied by the assistant on the supposedly anesthetic hand.

Some control experiments were done with each of the hypnotic *Ss* in the trance after the main experiment was over. The *S* held his hands in the confusion-position while the *E* touched him only on the left hand. The *S* also put his hands, palms down, on the table, with a distance of about 50 cm. between them, and both *E* and assistant stimulated the hand as usual. The *S*'s ability to report the number of stimulations received by the left hand in these two situations was practically perfect, as one would expect.

After the quantitative experimentation, each *S* had to answer the following questions in the trance. (1) Did all the touches seem to fall on the left hand? (2) Were you conscious of suppressing some touches that you felt, that is, not counting some of them?

In reply, all *Ss* said that they had felt nothing on the right hand, that all touches came on the left hand. *P*'s answer was not typical of the rest. When asked, "Did you have the impression that all touches came on the left hand?" he said, "I can't say that I did." "Your right hand has been anesthetic?" "Yes." "Why did you say that you didn't have the impression that they all came on the left hand?" "Because I didn't know where my left hand was." "You're certain that you felt nothing with the right hand?" "I have felt with only one hand, the left." These answers suggest that the *S* did feel something with the right hand; he reported some confusion, but maintained that his right hand had felt nothing.

The answer given by all to the second question was that they had not been aware of receiving touches which were not counted. The *Ss* were then asked, after the right hand had been rendered anesthetic by suggestion, to put their hands into the confusion-position again, and they were blindfolded. They were told to say "Now" whenever they felt a touch. Every *S* except *P* and *R* at one time or another reported "Now" when the touch fell on the right hand and failed to report when it fell on the left hand. *P*'s success seemed to depend on the fact that he was rather slow in reporting after being touched. *R* was rather prompt in reporting. It is significant that these two *Ss* made the fewest errors among the hypnotic *Ss*. They were both touched about 20 times, and in no case made an error.

At the conclusion of these experiments, the nature of the problem was explained to the *Ss*. It was hoped that they might make some comments of interest, but they made none. This result was probably to be expected, since they were in the trance, a condition usually unfavorable (though not always) to the making of statements indicating independent or spontaneous thinking.

To be complete, this experiment should contain another division, in which various stimuli are applied to the 'anesthetic' hand and the *E* tries to obtain later from the *Ss* a description of the stimuli received. This course was not followed, since the nature of the experiment had been explained to the *Ss* and *E* thought that this fact would vitiate the evidential value of data so obtained.

## Conclusions and Theoretical Considerations

*(1)* The suggestion of the anesthesia of one hand is effective only so long as the *S*'s hands are in a position which, in the non-trance state, would

not prevent him from knowing, when one hand is stimulated, which one is being stimulated. If, however, the hands are clasped in a position which renders this accurate knowledge impossible, the suggestion of anesthesia has no effect on the *S*'s performance, and he can count the touches received by the supposedly insensitive hand (when both are touched) no better than can a normal person who has no suggestion of anesthesia and who has his hands in the same position of confusion.

*(2)* The effect that the suggestion of anesthesia produces is an illusion on the part of the *S* that one of his hands is actually insensitive and that all the touches come to the unaffected hand. The only alternative to this conclusion is that the *S*s are consciously lying. There are several reasons for rejecting this latter hypothesis; namely: (a) The number of *S*s who, after reflecting on their past experiences, have ever admitted such a deception is either zero or very small. In the writer's experience, none ever has. (b) It seems unreasonable to suppose that a *S* who can be trusted to carry out instructions faithfully in an experiment in the normal state is so transformed by hypnosis that he knowingly lies to the *E* and undergoes painful stimulation to carry out the same purpose of deception. (c) It is probably easy to produce the illusion referred to, and the instructions given may act as a determinant of it, just as certain instructions may facilitate the production of a 'normal hallucination' in an unhypnotized person who is a trained introspector.[11] Such an illusion arose spontaneously in one of the normal *S*s tested and disturbed the testing so much that he had to be discarded. Through one of the first series, this *S* had the impression that all touches were falling on his right hand, and he could make no report at all on the number received by the left hand, which he had entirely "lost."

*(3)* Since the *S*s report that they are not failing to count some of the touches and we take this statement as truthful, and since at least in some cases there is evidence of an active process of suppression (*e.g.* 21 touches may be given and only 9 reported), it must be assumed that certain dissociated processes are working at the task of 'sorting out' or discriminating, so far as is possible, the impressions received from the two hands. These dissociated processes are not primarily cognitive—that is, they are not 'dissociated ideas'—but are conative in nature. The suggestion of anesthesia produces an illusion that an anesthesia actually exists and also a dissociation of certain conative tendencies which work, without the knowledge of the principal integrate of personality, in every way possible to make it appear to the *E*, whom the *S* wishes to please and to obey, that an anesthesia

[11] A. S. Edwards, An experimental study of sensory suggestion, this JOURNAL, 26, 1915, 99-129.

has actually been produced. This theory owes to Professor McDougall's general theory of hypnosis in terms of submission the idea that the dissociated processes are primarily conative in nature. While this study fails definitely to support McDougall's theory that anesthesias are genuine, nevertheless it offers considerable evidence in support of his general ideas on the subject of hypnosis.

This theoretical formulation is supported strongly, in the writer's opinion, by his study of hypnotically produced blindness, to which he has already referred.

# THE SENSITIVITY OF THE FINGERS TO ALTERNATING ELECTRICAL CURRENTS

By B. VON HALLER GILMER, Carnegie Institute of Technology

Electrical currents have been used as stimuli in numerous experiments, but until comparatively recent times very few attempts have been made to describe the quality of the experiences aroused.

In 1915, Von Frey reported the results of a study made to compare the sensations aroused by faradic currents and mechanical vibrators.[1] He used frequencies of current-alternation that varied up to 100 per sec. His electrodes were placed on one arm of his *S:* the anode, a broad wire-net cuff, on the upper arm; and the cathode, a fine pointed hair-brush saturated with a zinc solution, on various points of the arm. When 'pressure points' were stimulated they yielded experiences—"vibratory feelings"—which were quite similar to those aroused by mechanical vibration. With an increase in the intensity of the stimulating current, the "vibratory feeling" passed over into a powerful "hammering" which spread over large areas of the skin. At all of the sensory points of the skin, except the pressure, the sensations gradually became painful, cold, or warm. Von Frey, therefore, arrived at the conclusion that pressure receptors mediate the electrical stimuli as well as the vibratory.

In 1932 Crook, employing a 60~, 110-volt alternating current in a liquid medium, obtained sensory thresholds at the finger tips in terms of milliamperes.[2] This investigation involved a rather thorough analysis of the sensory aspects of electrical stimulation. Jackson and Riess, in 1934, made similar threshold measurements with 60~ A.C., in relation to different sizes of dry electrodes.[3] In 1935, Forbes and Bernstein, also using 60~ A.C., showed that neither voltage nor current alone could be used as an index of the electrical stimulus.[4] Their results showed that power must be used as the index in obtaining the stimulus-limen.

*Problem.* The present study is an outgrowth of the author's interest in ascertaining whether there is any similarity between the quality of the experiences aroused by alternating electrical currents and those aroused by mechanical vibration. Preliminary work done by the author,[5] experiments

* Accepted for publication March 16, 1936. This experiment was conducted in the Psychological Laboratory of the University of Virginia.

[1] Max von Frey, Physiologische Versuche über das Vibrationsgefühl, *Zsch. f. Biol.*, 65, 1915, 417-427.

[2] M. N. Crook, The sensory aspects of electrical stimulation, *J. Gen. Psychol.*, 6, 1932, 49-69.

[3] T. A. Jackson and B. F. Riess, Electrical shock with different size electrodes, *Ped. Sem.*, 45, 1934, 262-266.

[4] T. W. Forbes and A. L. Bernstein, The standardization of the sixty-cycle electric shock for practical use in psychological experimentation, *J. Gen. Psychol.*, 12, 1935, 436-442.

[5] B. von Haller Gilmer, The measurement of the sensitivity of the skin to mechanical vibration, *J. Gen. Psychol.*, 13, 1935, 42-61.

by Von Frey,[6] and the reports given by Crook's *Ss*,[7] seem to indicate that the sensations aroused by the two modes of stimulation are in some respects similar. Although we did not attempt in this study to determine the receptors involved by the two modes of stimulation, some knowledge regarding the receptors may be gained from a comparison of the sensory experiences aroused by these modes of stimulation.

*Apparatus.* The apparatus consisted of a General Radio Beat Frequency Oscillator, Type 613-B, equipped with an incremental pitch condenser and an attenuator calibrated in decibels. The oscillator generated frequencies from 5–12,500~ with relatively pure wave-form. The output of the oscillator was further amplified by a two stage Lafayette 2A3 push-pull amplifier capable of giving a large power factor without distortion. Leads were taken from the amplifier to two brass electrodes inserted in the bottom of a wooden, rubber insulated, finger stall. The electrodes, 2 mm. in diam., were beveled off smoothly at the edges. They were 10 mm. apart and projected about 3 mm. through the bottom of the finger stall. One electrode made contact with the volar side of the third phalanx of the right index or right middle finger, and the other electrode with a point 10 mm. distal to the first.

Voltage measurements were taken by a standard A.C. voltmeter whose range was 300 volts, and current measurements were made with an A.C. milliammeter whose range was 5 milliamperes.

The principle sources of error in the rectifier type of instrument are changes in temperature, wave-form, and frequency. The following precautions were therefore taken to insure constancy: the temperature of the experimental room was carefully controlled—the maximal variation was 2°F.; and sinusoidal wave-forms were used which were now and then checked by a cathode ray oscillograph.[8] The errors due to frequency changes were slight and constant. The instrument we used drifted 0.5% for every 1,000~ up to 35,000. Since this source of error was small and constant, no correction was made for it.

*Subjects.* The following served as *Ss* in this study: Dr. Harry M. Johnson (*J*); Mr. Rains Wallace (*W*); Mr. Paul Kendall (*K*); and Mrs. Ellen Gilmer (*G*). With the exception of *G*, all were experienced in cutaneous observation.

*Procedure.* Stimulus-limens in terms of milliwatts of power were taken for every *S* at the following frequencies: 64, 128, 256, 512, 1,024, 2,048, 4,096, 8,192, and 12,500~. Measurements were made on the forefinger of the right hand of *J* and *W*, and on the middle finger of the right hand of *K* and *G*.

The finger stall was so constructed that the contact between *S*'s finger and the electrodes was relatively constant during the experiments. Limens were obtained by a modification of the Method of Limits. Intensity was controlled by the attenuator and the potentiometer on the oscillator. Three ascending and 3 descending series were taken in alternate order with every *S* and every stimulus-frequency. We started the ascending series with a current well below the threshold and gradually increased its intensity until the "electrical sensation" was just discernible. The descending series

[6] Von Frey, *op. cit.*, 420.
[7] Crook, *op. cit.*, 53.
[8] F. A. Geldard and B. von Haller Gilmer, A method for investigating the sensitivity of the skin to mechanical vibration, *J. Gen. Psychol.*, 11, 1934, 301-310, esp. 306.

were started with a current slightly above the threshold. This was gradually reduced in intensity until the "electrical sensation" was just not noticeable. Care was taken not to use intensities far above the threshold, as fatigue and distracting after-effects were aroused by strong stimuli.

The limens were computed by the formula: $(V_aC_a+V_dC_d)/2$, where $V_a$ is the voltage on the ascending series, $C_a$ the current on the ascending series, $V_d$ the voltage on the descending series, and $C_d$ the current on the descending series. Thus the thresholds are expressed in power units (milliwatts). The measurements for a given frequency were made consecutively, without *S* removing his finger from the stall. *S* was, however, allowed to rest his finger on a pad of absorption paper after every threshold had been determined. *E* took care to see that moisture did not gather in the stall or on the electrodes, and that no stimulations were made while the after-effects of the previous stimulation were still running their course. This latter precaution was quite necessary at the higher frequencies. Every one of the 9 stimulus-frequencies were used in a day's observations. Generally the frequencies were presented in order from the lowest to the highest. On a few days, however, the frequencies were used in haphazard order. The different orders of presentation did not, however, produce a noticeable effect in the results.

The *S*s could not closely observe the apparatus settings and had no knowledge of the threshold readings until after the day's observation. In some experiments, the *S*s knew the frequencies with which they would be stimulated and in others they did not. Knowledge regarding the stimulus-frequency to be used did not affect the results.

At the conclusion of the experiments with every stimulus-frequency, *S* gave an introspective description of his experiences. Then, after limens for all of the frequencies had been obtained he was restimulated with every stimulus-frequency in turn and asked to give a running description of his experiences as the stimulus-intensity was gradually increased from the limen to a point where the sensations aroused became painful and unpleasant.

Threshold measurements were made on *J* and *W* at 7 observational periods, on *K* at 10 periods, and on *G* at 8. The differences of the average liminal values among our *S*s are so slight that we feel justified in averaging the data. These averages are shown in the accompanying table and figure.

*Results.* Table I shows the combined data for all our *S*s. The average threshold determination is given at each of the nine different frequency levels together with its standard error. Fig. 1 shows the combined threshold values at every frequency in the form of a curve. Here the power, expressed in terms of milliwatts, necessary to elicit liminal sensation is plotted vertically on an arithmetic scale as a function of the frequency, in terms of cycles per second, which in turn is plotted horizontally on a logarithmic scale. It will be noted that at the higher frequences the standard error of the threshold measurements increases with each frequency level. Here the "electrical feelings" cease to be of a vibratory nature, changing over into patterns of pricking pain and psychological heat, the *S*s reporting difficulty in determining the exact point where the feelings are first observed. The threshold average given at 12,500~ is questionable.

In determining the threshold values in power units the important variable is that of current, ranging from around 0.3 milliampere at 64~ up to 3 milliamperes at 12,500~. The voltage ranges from around 100 volts up to 130 volts from the lowest to the highest frequency. There is a gradual increase in both current and voltage as the frequency is raised, save at 256~. Here the voltage drops slightly with a considerable drop in current.

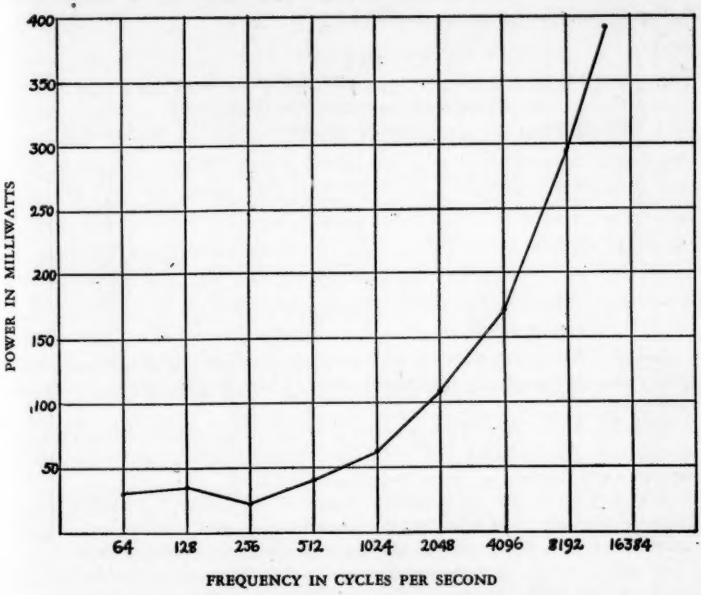



FIG. 1. CURVE OF THE COMBINED THRESHOLD VALUES

It is to be noted from Fig. 1 that the highest degree of sensitivity is at the frequency of 256~. With the exception of this drop at 256~, there is a gradual increase in the amount of power necessary to barely elicit a liminal sensation as the frequency is increased. It is interesting to compare these data with those obtained through stimulation by mechanical vibration, where the frequencies were the same and where 256~ was the most sensitive frequency.[9] *W* and *K* had served as *S*s in the vibration experiments.

The verbal reports of the *S*s are of interest. All of them gave similar descriptions from time to time, therefore, only a summary of these reports

[9] Von Haller Gilmer, *op. cit.*, 55 f.

will be given. This summary gives the descriptions of the sensations felt at the threshold of shock followed by reports of the feelings when the electrical intensity was increased gradually to a point where the *Ss* could no longer maintain their position.

*Stimulus: 64~.* At the threshold the sensation is an intermittent flutter, similar to vibratory sensations, localized at the front elecrode. Increasing the intensity causes this feeling to extend to the tip of the finger in a narrow stream. The vibratory feeling seems to have a greater amplitude.

TABLE I

THE AVERAGE FREQUENCY-POWER THRESHOLDS WITH THEIR STANDARD ERRORS FOR THE COMBINED DATA OF THE FOUR OBSERVERS

| Cycles (per sec.) | Limen (in milliwatts) | Standard error |
|---|---|---|
| 64 | 30.88 | .52 |
| 128 | 34.33 | .58 |
| 256 | 24.29 | .54 |
| 512 | 41.85 | .38 |
| 1024 | 63.02 | 1.21 |
| 2048 | 108.66 | 2.30 |
| 4096 | 170.25 | 3.64 |
| 8192 | 295.29 | 6.80 |
| 12500 | 392.00 (?) | — |

*Stimulus: 128~.* The flutter is like that above with no noticeable change in frequency rate. As the intensity is increased there is a heat pressure localized at the end of the finger.

*Stimulus: 256~.* The fluctuations seem to be smoothing out, however, still sensed as vibration. The frequency rate is the same. Localization is at both electrodes. A warm, painful pressure is present at the higher intensities.

*Stimulus: 512~.* The same flutter is found as those above, but sharper. An increase of intensity causes warm painful pressure spurts which spread out from the electrodes. Two *Ss* report that the front electrode seems to be moving about.

*Stimulus: 1024~.* At the threshold there is a fluttering heat localized in the tip of the finger. The flutter is faster and finer than those above, but much slower than the actual frequency. Increasing the intensity spreads the sensation over a larger skin area, and the discrete vibrations are no longer perceptible, the feeling being one of pricking pain.

*Stimulus: 2048~.* The sensation is much sharper and "hotter" than the one above, with localization at both electrodes. A slight intensity increase causes a stream of painful pressure to run from the electrodes to the end of the finger. Further increase of intensity causes this stream to divide into a fork at the tip of the finger. Both electrodes seem to be moving about.

*Stimulus: 4096~.* A pricking sensation is localized in the end of the finger, sharp and painful. This feeling streams back to the electrodes as the intensity is raised. This stream is extremely narrow.

*Stimulus: 8192~.* Perhaps the feeling could be described as psychological heat. One *S* reports a rather slow beat, not confused with the heart beat, localized between the electrodes.

*Stimulus: 12,500~*. The feeling is of psychological heat which comes in rather gradually; an accurate determination of the limen is difficult to obtain.

As for a general interpretation of the results, one can see a marked similarity between some of the experiences obtained through stimulation by alternating electrical current and those sensations aroused through stimulation by mechanical vibration. This comparison can be made only for the lower range of frequencies, since sensitivity to mechanical vibration reaches an upper limit around 2600~.[10] Above this limit no discrete vibratory feelings can be perceived, the sensations being those of steady pressure. At the lower frequencies of electrical shock the sensations are of an intermittent, vibratory nature. It is difficult to say at just what frequency of the electrical shock the discrete flutterings or vibratory sensations cease. As we ascend the frequency scale, the vibratory feelings gradually shade into pricking sensations, through a pattern of warmth into what may be described as psychological heat. It is interesting to note that the most sensitive frequency to electrical shock is at 256~ which compares with a high degree of sensitivity to smoothly contacting mechanical vibration at 256~.[11] The after-sensations of the electrical shock are of a tingling nature at the lower frequencies, producing burning feelings at the higher frequencies.

There is evidence of some relationship between the sensitivity of the fingers to alternating electrical stimuli and the sensitivity to mechanical vibration. This may be indicative of some common receptor-mechanism operating for the two different modes of stimulation.

---

[10] Von Haller Gilmer, *op. cit.*, 54. [11] *Ibid.*, 55 f.

# THE PHI TEST OF LATERAL DOMINANCE

By HERBERT H. JASPER and EDWARD T. RANEY, Emma Pendleton Bradley Home and Brown University

Monocular preference in sighting has been used extensively as an important index of general lateral dominance. This aspect of lateral dominance is considered of importance relative to the most highly integrated forms of behavior involving the delicate coördination of bilaterally innervated muscle groups as in speech and reading. There is, however, no adequate analysis of the fundamental nature of ocular dominance, its relationship to the motor or perceptual aspects of the visual system, and its functional importance in the language mechanism.

One reason for the confusion which occurs in attempts to explain the integrative function of the two eyes lies in the complex anatomical nerve pathways which control the motor and the sensory visual processes. Ocular dominance in monocular sighting is predominantly a motor function since it has been shown that the dominant eye, as determined by the Manoptoscope and Paper Sighting tests is not related to the eye possessing the best visual acuity.[1] Ocular dominance in sighting should be more clearly related to handedness since it is concerned with the motor system. There is, however, only a moderate degree of relationship between motor-eyedness and left-handedness.[2] It is clear that lateral dominance, even in motor processes, may not be a completely unilateral function.

A clear distinction should be made between ocular dominance as tested by predominant eye-preference in monocular sighting and lateral dominance in visual perception. This distinction is necessary because, first, the sensory and motor aspects of the visual mechanism need not necessarily show the same laterality of dominance and, secondly, the central representation of each eye is bilateral so that cortical dominance in perception is related to one-half of each eye while cortical dominance in the control of eye movements and in tests for retinal rivalry may be related to only one eye. In a comparison of the peripheral sensory aspects of ocular dominance (measured by tests of retinal rivalry) and the motor aspects, Washburn, Faison, and Scott have shown that ocular preference in sighting is related, as would be expected, more closely to handedness, but is not closely related to the dominant

* Accepted for publication February 10, 1937.

[1] Lawrence Gahagan, Visual dominance-acuity relationships, *J. Gen. Psychol.*, 9, 1933, 455-459.

[2] H. H. Jasper, A laboratory study of diagnostic indices of bilateral neuromuscular organization in stutterers and normal speakers, *Psychol. Monog.*, 43, 1932, (no. 194), 72-174; Ruth Updegraff, The correspondence between handedness and eyedness in young children, *Ped. Sem.*, 42, 1933, 490-492.

eye in tests of retinal rivalry.[3] Only 33% of the *Ss* showed agreement between the preferred eye in monocular sighting and that in tests of retinal rivalry. Keller found a consistency of only 48% between the Stereoscope and the Manoptoscope tests of eye preference, 40% with the Paper Sighting test, and 34% with the Convergence test.[4] These results indicate that unilateral dominance may not be a *general* orientation of neural organization, but may be *specific* for the different nervous mechanism involved. It may be determined by the specific properties of a given nervous mechanism rather than upon any general unilaterality of function.

There are three possibilities of asymmetric function in the visual mechanism: (1) dominance in the motor control of the eyes; (2) dominance in the receptor mechanism of the eye itself; and (3) dominance in the central projection areas of the two eyes. Each of these three types of dominance may be quite independent. The present paper is concerned primarily with an attempt to determine the lateral dominance in the visual projection areas, as distinguished from unilateral dominance of the peripheral receptors and dominance in the motor control of the eyes.

Previous attempts to determine the laterality of cortical dominance in visual perception have made use of tachistoscopic exposures of a line of letters, digits, or figures to determine the relative amount of retention of material exposed in the right or left visual field. The results obtained indicate that the left-eyed *Ss*, according to sighting tests, may see a point in the right field more easily than in the left, and conversely that right-eyed *Ss* may see a point in the left field more easily than in the right. Laterality of function as measured by an index of manual habit preferences does not seem to affect materially this performance according to Anderson and Crosland.[5] Burke and Dallenbach,[6] and White and Dallenbach,[7] however, found that a point in the left visual field has a greater attention value for right-handed *Ss*, the reverse being true of left-handed *Ss*.

Since eyedness as tested by monocular sighting is related to ocular muscle efficiency,[8] it is quite possible that Crosland's results might be interpreted on the basis of the dominant eye tending to overconverge in the strain of fixation which would bring more of the right visual field in the central portion of the left eye. Consequently the material in the right visual field would be perceived more

[3] M. F. Washburn, C. Faison, and R. Scott, A comparison between the Miles A-B-C method and retinal rivalry as tests of ocular dominance, *Proc. Nat. Acad. Sci.*, 19, 1933, 773-777.

[4] M. E. Keller, Ocular dominance and the range of visual apprehension, unpublished thesis, Brown University, May, 1933.

[5] I. Anderson and H. R. Crosland, The effect of eye-dominance on range of attention scores, *Univ. Oregon Publ.*, 4, 1933, 23; The effects of handedness on range of attention scores, *ibid.*, 4, 1934, 16; The effects of combination of handedness and eyedness on center-position range of attention scores, *ibid.*, 4, 1934, 48.

[6] R. S. Burke and K. M. Dallenbach, Position versus intensity as a determinant of attention of left-handed observers, this JOURNAL, 35, 1924, 267-269.

[7] A. M. White and K. M. Dallenbach, Position versus intensity as a determinant of the attention of left-handed observers, *ibid.*, 44, 1932, 175-179.

[8] Blake Crider, The relationship of eye muscle balance to the sighting eye, *J. Exper. Psychol.*, 18, 1935, 152-154.

readily by left-eyed individuals while the material in the left visual field would be perceived more clearly by right-eyed individuals. The majority of the results of his study, however, are not statistically significant. The general tendency is more pronounced when the material is presented monocularly.[9] This method for the determination of dominance in visual perception is subject to the influence of reading habits which tend to control the visual field in which the greater facility of perception will be shown, so that it would be desirable to use a method of testing as free as possible from this defect.

In the present research, asymmetry of function in the perception of direction of movement in the phi phenomenon was utilized to obtain indications of unilateral dominance in the field of perception. The principles involved in this test have been previously described.[10] The present report is concerned with the description of an improved portable binocular phi apparatus together with reliability measurements and further comparisons with other indices of dominance.

## Method and Procedure

*Technique.* Two lights are so arranged that conditions for the perception of phi movement are simultaneously presented to both eyes (Fig. 1). Fixation is held either at a near point (about 38 cm. in front of the eyes) or at a far point (about 142 cm. in front of the eyes) and the two lights are alternated at a frequency of 1.5 per sec. The retinae of the left and right eyes are both stimulated on the foveal areas, since a point is being fixated, and on non-corresponding points, since the non-fixated point will be seen in a double image. The homonymous doublings of the far point at near fixation fall on the nasal halves of each retina so that the right doubling is related to the right eye and the left hemisphere while the left image is related to the left eye and the right hemisphere (see Fig. 1, Near Fixation). At far fixation the heteronymous doublings fall on the temporal halves of each retina so that the right image is now related to the left eye and the left hemisphere and the left image is related to the right eye and the right hemisphere (see Fig. 1, Far Fixation).

Stimulation was equal for perception of movement both to the right and to the left simultaneously. If movement is reported in only one direction it may be said to indicate a lateral dominance in some part of the visual mechanism. For example, when the near point is fixated and movement to the right is reported, it is assumed that the dominant mechanism may be the left half of the retina of the right eye or the central visual mechanism of the left hemisphere (R-eye,

[9] Keller, *op. cit.;* S. I. Franz and J. D. Layman, Studies in cerebral function: I. Peripheral retinal learning and practice transfer, *Publ. Univ. Calif. Los Angeles, Educ., Phil., Psychol.*, 1, 1933, 65-78; S. I. Franz and S. Kulduff. II. Cerebral dominance as shown by segmental visual learning, *idem.*, 79-90; S. I. Franz and R. C. Morgan. III. Transfer of effects of learning from one retinal area to other retinal areas, *idem.*, 91-98; and S. I. Franz and E. F. Davis. IV. Simultaneous reading with both cerebral hemispheres, *idem.*, 99-106.

[10] Jasper, *op. cit.;* E. T. Raney, A phi-test for the determination of lateral dominance involving the visual perception of movement, *Psychol. Bull.*, 32, 1935, 740.

L-hem.) since the left halves of both retinae are connected through the optic chiasma to the left hemisphere. When the far point is fixated, if movement to the right is reported, it might be assumed that the left half of the left eye is dominant, or, again, the left central visual process (L-eye, L-hem.). Since the right eye or left central process is dominant at near fixation and the left eye, or the left central process is dominant, at far fixation, the conclusion is drawn that right unilateral dominance in this perception of movement must depend upon the dominance of the left central visual mechanism and no ocular dominance is indicated (R-eye, L-hem.—L-eye, L-hem.). Similarly reported movements to the left at

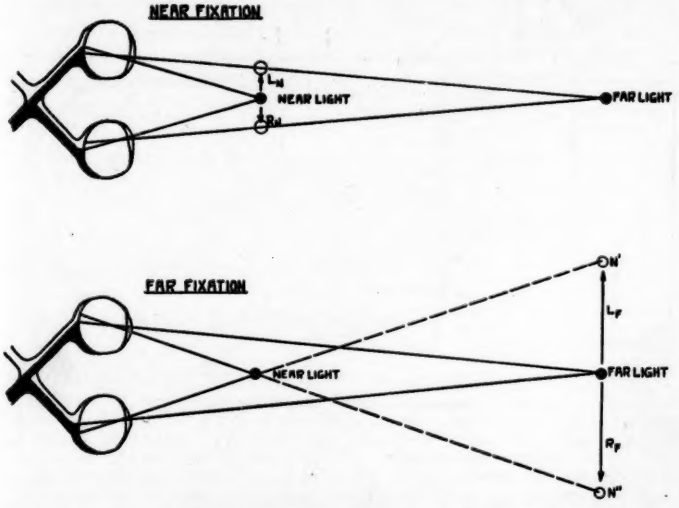



FIG. 1. SCHEMATIC DIAGRAM SHOWING THE PRINCIPLES OF THE PHI TEST

both near and far fixation would indicate right central dominance, commonly called left dominance with reference to handedness (L-eye, R-hem.—R-eye, R-hem.).

Movement reported to the right at near fixation and to the left at far fixation indicates right ocular dominance and no central dominance since the right eye, or the left central process is involved in near fixation and the right eye, or the right central process is involved in far fixation (R-eye, L-hem.—R-eye, R-hem.). The opposite condition, left movement at near and right movement at far fixation, would indicate left eye dominance (L-eye, R-hem.—L-eye, L-hem.). The other possibilities which have appeared are a reported simultaneous movement in both directions and a reported alternation of movement. These conditions are regarded as indicating either unstable dominance or ambilaterality.

*Apparatus.* The apparatus used consisted of a light-tight rectangular box in which were placed the points of fixation illuminated by standard neon lights. A second box containing a phonograph motor which operates the double contact

commutator for the alternate exposure of the near and far lights completes the necessary equipment. A diagram of this set-up is shown in Fig. 2.

*Procedure.* In administering the test no explanation regarding its nature was given. *S* was asked to look at the point of light in the box (the near light was turned on). When he reported that he saw only one light, he was warned to be sure to

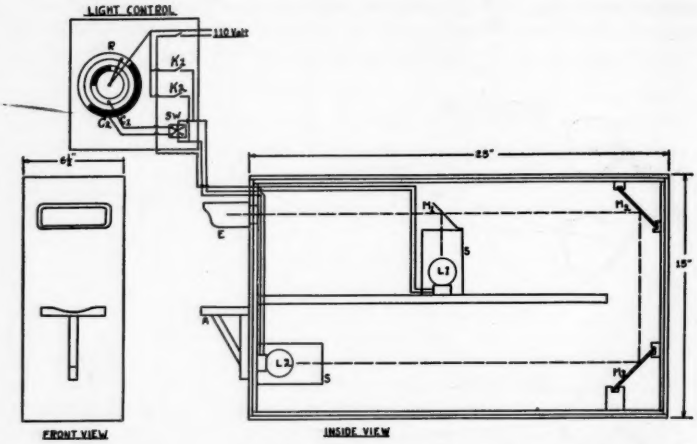



FIG. 2. DIAGRAM OF THE FRONT AND INSIDE VIEWS OF THE APPARATUS

E represents the metal shield for the eyes and A the chin support. $L_1$ and $L_2$ are standard neon lights covered with metal shields, S, except for a small aperture in the end of the shield can, which is somewhat larger for the far than for the near light. $M_1$ is a narrow surface mirror (6 mm.) placed in the center so as not to obstruct binocular vision of the far light ($L_2$). Surface mirrows $M_2$ and $M_3$ are placed so as to line up, both vertically and horizontally, the near and far points of fixation. The commutator R is turned about 1.5 r.p.s. by a phonograph motor making contact alternately to the near and far light through the brushes $C_1$ and $C_2$. Contacts are made on the inked portions of the commutator, ⅛ of the circumference being left between each to allow an interval of 80 to 90 ms. between exposures. The light fixated is given a longer exposure (734 ms.) as compared to the non-fixated light (100 ms.) so as to facilitate the maintenance of the point of fixation, minimizing eye-movements. The polarity reversing switch SW permits changing the longer exposure-time from the near to the far light, depending upon which is being fixated. $K_1$ and $K_2$ permit the constant exposure of the near or far point to facilitate the establishment of fixation before starting the rotor.

keep his eyes fixed on this light. The second or far light was then turned on, and he was again asked to report what he saw. If he did not report 3 points of light the above procedure was repeated until he was able to fixate the near light well enough to get a double image from the far light. When *S* was able to perceive 3 lights he was asked if the point of light was exactly in the center of the points on either side. His head was then adjusted until the doublings appeared equally spaced about the point fixated.

The far light was now turned off and *S* was again asked to look at the remaining light and not to pay attention to any other lights in the box. He was then told that the light he was matching was going to move and he should report in what direction it was moving. No suggestion was given as to which direction it might move. The alternating lights were then turned on, and he was given several minutes to decide in which direction the light was moving. If he reported right or left or up or down, he was encouraged to look again and make sure. As a rule, 10 or even 15 or 20 min. of observation was necessary before *S* began to perceive genuine apparent movement. During this time the alternating lights were turned off occasionally and the front light turned on again in order to be sure that *S* was fixating the near light.

*S*'s report on the direction of phi-movement was checked by placing three corks with matches stuck in them to represent the lights on top of the test-box. *S* arranged them as the stimulus-lights were seen. He was then asked to pick up the center match and move it in the same direction as the light was moving. Several precautions were necessary to obtain reliable results.

(1) First reports should be disregarded entirely since *S* seldom perceived the phi-movement before he had observed the lights from 4 or 5 min. and sometimes did not see it until 15-25 min. In the meantime, in an effort to answer *E*'s question, he would report movement before actually seeing it. When real phi-movement occurred *S* usually remarked that now he saw what the examiner meant, the light is moving in such and such directions. When genuine phi-movement occurred it was, in most cases, consistently reported in one direction.

(2) Care should be taken to see that *S* is reporting the direction in which the fixated light is moving. If he reports on one of the doublings reported, movement toward the left would be a movement on the right of the center if the right doubling is reported to move to the left. This would be called a right movement since it involved the right visual field.

(3) An objective test is necessary in order to be sure that *S* is not confused in lateral orientation, reporting right when he means left and vice versa.

(4) The test should be administered only by one who sees the phi-movement himself and understands its principles as here employed.

When *S* had given a clear report on the near light, the same procedure was used with the far light. More difficulty was shown in fixating the far light. For this reason it was necessary to check the perception of only 3 lights (rather than 2 or 4 which occur as a result of poor fixation).

## Results

*(1) Reliability.* In this paper results on 44 cases are presented.[11] All cases were boys between the ages of 9 and 12 yr. who were judged by the teacher to be making at least an average all-round adjustment to the school situation. No selection was made in regard to dominance. Every *S* was tested on two occasions, with a four weeks' interval between the two testing periods. The battery of tests included the Phi Test as described; a questionary of 20 items chosen from Koch's study that had a reliability of 90 or

[11] The children used in these experiments were obtained through the coöperation of Mr. L. R. Thomas of the Moses Brown School.

more with tests of actual performance;[12] ocular preference tests, including the Manoptoscope and Paper Sighting tests; and finally the Van Riper Critical Angle Board which is a test of orientation during simultaneous writing or copying a drawing with both hands.[13] On every test, *S* was given a rating of right, left, or ambilaterality.

On the Phi Test, one *S* had a bad strabismus of the right eye. Another was apparently unable to perceive movement. Out of the remaining 42 *S*s, 30 were right central, 6 right-eyed, 4 left central, 1 left-eyed, and 1 indeterminate. On a retest, 32 were right central, 4 right-eyed, 4 left central, 1 left-eyed, and the above-mentioned indeterminate case. If central and eye-dominance are combined there were 86% right dominant, 12% left dominant, and 2% indeterminate. No ambilateral conditions were reported. On the retest, according to this classification consistency into right or left dominance was 97%. According to consistency of report (identical directions of movement for both near and far fixations) the reliability was 90%.

TABLE I

PERCENTAGE AGREEMENT AND RELIABILITY OF DOMINANCE TESTS

| Test | Test number | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 1. Phi Test | 90–97 | | | | | |
| 2. Handedness Index | 85 | 95 (est) | | | | |
| 3. Visual Pattern | 78 | 74 | 76 | | | |
| 4. Word Pattern | 74 | 69 | 81 | 78 | | |
| 5. Manoptoscope | 65 | 62 | 50 | 50 | 76 | |
| 6. Paper Sighting | 63 | 57 | 52 | 52 | 81 | 93 |

*(2) Comparison with other measures of dominance.* The relations between the Phi Test and other tests of lateral dominance in terms of the percentage of cases showing the same laterality is given in Tables I and II. Percentages between 40 and 60 cannot be safely considered as due to other than chance relationships.

The results of the Phi Test are more closely in agreement with laterality according to selected manual habit preferences than with the other tests of dominance used in this study. The agreement between the Phi Test and tests of ocular dominance in monocular sighting is only a little better than chance and the same is true for handedness and eyedness. Only chance

[12] H. J. Koch, A study of the nature, measurement and determination of hand preference, *Genet. Psych. Monog.*, 8, 1933, 117-221.

[13] C. van Riper, A new test of laterality, *J. Exper. Psychol.*, 17, 1934, 305-313.

agreement was found between eyedness and laterality according to the Critical Angle Board. There is a significant but not good agreement between the results of the Critical Angle Board test and the Handedness Index and Phi Tests.

The reliability of the Phi Test is as good as the Handedness Index and the Paper Sighting test and better than the Manoptoscope and the Critical Angle Board tests.

The percentage of right dominance, left dominance, and ambilaterality found in this group of 42 *Ss* is given in Table II.

TABLE II

PERCENTAGE RESULTS ON FOUR DOMINANCE TESTS
(42 cases)

| Test | Right dominance | Ambi-laterality | Left dominance |
|---|---|---|---|
| Phi Test | 86% | | 12% |
| Handedness Index | 93% | 5% | 2% |
| Critical Angle Board | 76% | 15% | 9% |
| Ocular Dominance: | | | |
| Manoptoscope | 68% | 5% | 27% |
| Paper Sighting | 63% | | 37% |

## SUMMARY AND CONCLUSIONS

An apparatus has been described for the determination of unilateral dominance in the central as opposed to the peripheral ocular aspects of the visual-perceptive system. This test, called the Phi Test, makes use of the direction of apparent movement between near and far points of fixation and the homonymous and heteronymous double images. A reliability of 90 to 97% was shown by a retest of 42 *Ss*. Relationships with other tests of lateral dominance are discussed.

# THE CONCEPT 'EYE-PREFERENCE'

By C. E. BUXTON and H. R. CROSLAND, University of Oregon

Clinical and experimental psychologists have had occasion to determine the eye preferred by their *Ss* in unilateral sighting situations. With few exceptions the tests used for such determinations have been very simple, 'all or none' in the sense that an individual was declared to be right-eyed or left-eyed, or in a few cases where *E* was not sure of the results, ambi-ocular.

The major aims of this research are two: (1) to ascertain the statistical reliability of simple performance tests of eye-preference; (2) to determine the degree of relationship between behavior forms sampled by such tests. The term 'eye-preference' here signifies only the choice of either eye in unilateral sighting, whether this choice be deliberate or unwitting. There are, at first glance, two techniques of quantifying an eye-preference test. The first technique consists of determining the 'amount' or 'degree' of preference in a given situation.[1] The second technique involves repeating the simple test with such frequency, in slightly varying ways, that results of a large number of comparable situations may be combined. The latter technique is chosen here and will be described later.

Many eye-preference tests are developments or modifications of the Porta staff test.[2] The task in each instance is to 'line up' a near, vertical object with a fixated, far, vertical one, *e.g.* a pencil at arm's length with a window casing. *E* notes whether the near object is placed in the right or left-line of vision. The hole-in-card test of Durand and Gould has been used in many forms.[3] The original test was designed to show which eye was preferred in sighting at an object through a mailing-tube mounted to pierce a cardboard. In a common revision, the mailing-tube is omitted; *S* holds a cardboard in both hands and through a hole in it locates a certain object. *E* has merely to note which line of vision is preferred. From Wray's ring-sighting test have developed both simple and complex tests.[4] In these *S* brings into the line

* Accepted for publication January 16, 1936.

[1] Cf. F. H. Lund, The monoptometer: A new device for measuring eye-dominance, this JOURNAL, 44, 1932, 181 f.; N. B. Cuff, A manoptometer, *ibid.*, 42, 1930, 639. For a criticism of such devices see B. Crider, A criticism of Lund's and Cuff's apparatus and tests of ocular dominance, *ibid.*, 47, 1935, 312 f.

[2] Cf. O. Rosenbach, Über monokulare Vorherrshaft beim binokularen Sehen, *Münch. Med. Woch.*, 50, 1903, 1290-1292; Cf. also C. Sheard, Editorial, *Amer. J. Physiol. Optics.*, 4, 1923, 49 f.; A. M. and M. Snyder, Eye preference tendencies, *J. Educ. Psychol.*, 19, 1928, 431-433; C. Selzer, Lateral dominance and visual fusion, *Harvard Monog. in Educ.*, No. 12, 1933; P. Lineback, Some observations on the mechanism of double vision, *Anat. Rec.*, 38, 1928, 193-201.

[3] A. C. Durand and G. M. Gould, A method for determining ocular dominance, *J. Amer. Med. Assoc.*, 55, 1910, 369-370. Cf. also P. Dolman, Tests for determining the sighting eye, *Amer. J. Ophthal.*, 2, 1919, 867; N. Scheidemann and H. Colyer, Reversing the handedness of some left-handed writers, *J. Educ. Psychol.*, 22, 1931, 191 f.; L. Gahagan, Visual dominance-acuity relationships, *J. Gen. Psychol.*, 9, 1933, 455-459.

[4] C. Wray, Right handedness and left brainedness, *Lancet*, 1, 1903, 683. Cf. also J. Downey, Types of dextrality and their implications, this JOURNAL, 38, 1927, 317-367; D. W. Oates, Left-handedness in relation to speech defect, intellect, and achievement, *Forum Ed.*, 7, 1929, 91-105; F. H. Lund, The monoptometer; a new device

of vision some form of ring, *e.g.* a common finger ring, and sights through it at a fixation-object. The most widely used test has been the Parsons manuscope test,[5] or variations of it. The original instrument was described as a camera-like chamber or hood which fitted over the upper face in the manner of a stereoscope, whence it tapered to a circular aperture, thus closing off part of the visual field. *S* fixated an object through the aperture and in so doing revealed his choice of eye for the act. Under the title of aiming tests may be grouped varying attempts to discover which eye is used in aligning objects with a far fixation-point.[6] Whereas in the majority of previously named sighting tests the choice of eye is nearly 'unconscious,' aiming tests often are used to detect the presence of a strong habit. Telescopes, rifles, pistols, mailing-tubes, and similar implements are employed. *S* may be allowed to close one eye alone or be permitted to hold the instrument in his favored hand. *E* in any case notes which eye is chosen for the sighting.

One representative of each of the four 'categories' of tests described above was chosen for use in our investigation. As suggested previously, each simple test was repeated many times in slightly varying ways, and it is therefore necessary to describe these variations in successive trials.

*Test 1.* In Test 1 we employed the manuscope (Stoelting, sheet zinc), a truncated cone shaped to fit over the eyes. The whole field of vision is thus closed off, except for a small area visible through the small aperture of the manuscope. *S* fixated an object through this opening and *E* noted which eye was used. To vary this test, 10 cards in succession were held before *S* at a distance of 8 ft. Figures on the cards were large and simple, so that acuity could not be a factor in choice of eye for perceiving and reading the card. For each of 5 trials *S* brought the manuscope to his eyes with both hands; for 5 more trials *S* steered with his forehead a second manuscope pivoted on a shaft.

*Test 2.* In Test 2 we used the hole-in-card, which consisted simply of a sheet of black cardboard, 12 x 20 in., with a centrally located hole, one-half in. in diameter. *S* held the card in both hands and observed through the hole each of 10 cards presented by *E*. Again the figures were of such a size that acuity hardly could have governed the choice of eye for reading. In the actual procedure distances of the card from the eyes of *S* and the angles with the body at which he held it were systematically varied, but since these variations affected the choice of eye very little they are not discussed in this report. When *S* raised the card, *E* stood before him and turned over the card to expose the figure—*E* thus was able to determine directly which eye *S* was using.

---

for measuring eye-dominance, this JOURNAL, 44, 1932, 181 f.; H. Koch, Nature, measurement, and determination of hand preference, *Genet. Psychol. Monog.*, 13, 1933, 117-221.

[5] B. F. Parsons, *Left-handedness,* 1924, 1-185. Cf. also W. Miles, Ocular dominance demonstrated by unconscious sighting, *J. Exper. Psychol.*, 12, 1929, 113-126; Ocular dominance in human adults, *J. Gen. Psychol.*, 3, 1930, 412-430; E. Hogben, Observations on sidedness in use of hand and eye, *J. Med. Assn. S. Africa,* 4, 1930, 31-34; K. Gordon, A study of hand and eye preference, *Child Dev.*, 2, 1931, 321-324; R. Updegraff, Ocular dominance in young children, *J. Exper. Psychol.*, 15, 1932, 758-766; N. B. Cuff, Study of eyedness and handedness, *J. Exper. Psychol.*, 14, 1931, 164-175; F. D. Comfort, *op. cit.:* M. Monroe, *Children Who Cannot Read,* 1932, 1-205.

[6] Cf. D. W. Oates, *op. cit.;* C. Quinan, The principal sinistral types, *Arch. Neurol. & Psychiat.*, 24, 1930, 35-47.

*Test 3.* Test 3 was ring-sighting. *S* looked through a mounted stereoscope hood, without lenses or centerpiece, at a horizontally placed strip of cardboard, which bore a series of figures. The field of vision was limited to the cardboard strip. *S* brought up from below into the field of vision a gray-iron washer, with a half-inch hole, mounted on a 6-in. shaft, and quickly encircled whatever figure *E* named. The hands holding the shaft were alternated and chance-order figures fixated. *S* could not see his hands; *E* rapidly determined which eye fixated a figure by obstructing vision of either eye with a cardboard before the hood and asking *S* to report the effect of this act. Ten trials were taken, each varying according to figure fixated and hand used to hold the ring.

*Test 4.* Test 4, representative of tests in which a habit is sought for and observed, was an aiming test. Two washers similar to that described just above, were mounted at the ends of a 12-in. piece of light wood; the latter was fitted with a handle, so that the instrument was roughly analogous to the sights of a gun held in one hand. Again *S* fixated and named a series of 10 figures; *E* had but to notice which eye was used in the various trials—for here *S* usually closed an eye, squinted, and shifted body position. In this test also the angles with the body at which the 'gun' was held, and the distances of the rear 'sight' from the eye were varied, but the choice of eye was so little affected by these changes in the test that they are not discussed in this report.

It is to be emphasized that in each test *S* fixated relatively quickly and was not allowed to shift from one eye to the other on any one attempt. We did not know just how much influence might be exerted upon the choice of eye for a given trial by the choice of hand for holding the instrument. Therefore we sought in three tests to control the effects of handedness. In the manuscope and hole-in-card tests, *S* held the instrument in both hands; in the ring-sighting test, he alternated hands in strict order. However, in the aiming test he was permitted to hold the 'gun' in either hand.

Naïve *S*s, such as were used in this study, only rarely become aware of the fact that they are exhibiting eye-preference behavior until they are nearly through with the tests. Many do not even then realize that *E* is noting choice of eye, because the expressed aim of each test is for *S* to name a figure or letter which is large enough to be clearly visible.

A method of scoring which previously has been used in scoring hand-preference tests was utilized here.[1] For any single trial on which *S* chose the right eye, a score of +1 was given, and for a choice of the left eye, −1. It is seen that any individual could score within the range of +10 to −10; a *plus* (total) score indicated a position in the scale toward complete right-preference; and a *minus* (total) score indicated any tendency toward left-preference. This was a fairly satisfactory range for purposes of correlation. The major assumption is that for any *S* the strength of preference for either eye is expressed in the relative number of times he chooses each eye in a series of unilateral sightings.

In Table I are given the reliabilities of every test, on the basis of 'odd-even' scores, and of the tests pooled (four test scores summated). Included in addition to the reliability coefficients are the reliabilities, estimated by the Brown-Spearman formula,

[1] H. H. Jasper, A laboratory study of diagnostic indices of bilateral neuro-muscular organization in stutterers and normal speakers, *Psychol. Monog.*, 43, 1932, (no. 194), 72-174.

for the full length of test. With but one exception the estimated reliability coefficients are above 0.90. Thus they all far exceed Kelley's criterion of minimal reliability ($r = 0.45$) for group measurement.[8] The minimal reliability for individual diagnosis, according to Kelley, is 0.94. This is exceeded by the coefficients of the hole-in-card and aiming tests and approached by the remaining coefficients and the coefficient for the tests pooled. It is to be concluded that such simple performance tests of eye-preference as were here administered, with such controls as were present, are quite reliable.

TABLE I

RELIABILITY COEFFICIENTS OF TESTS OF EYE-PREFERENCE

(N=86)

| Test | Rel. coefficient | Est. rel.* |
|---|---|---|
| Manuscope | .78 | .87 |
| Hole-in-card | .97 | .98 |
| Sighting | .84 | .91 |
| Aiming | .92 | .96 |
| Tests Pooled | .85 | .92 |

* These values are estimated for full length of test by means of the Brown-Spearman formula: *est.* $r = 2r/1+r$.

It is evident from Table II that, so far as our tests go, the level of intercorrelations among them does not seem to indicate the existence of a 'unitary' trait of eye-preference (one which would be consistently expressed in eye-preference situations). In other words, although *E* may know that *S* exhibits a certain degree of right-preference in one test, he can not predict that *S* will show a corresponding degree of right-preference in another test, or, indeed, that he will not show left-preference.

The significant findings of this research are two: (1) typical simple tests of eye-preference, when repeated in slightly varying ways a relatively large number of times,

TABLE II

COEFFICIENTS OF INTER-VARIABLE CORRELATION OF TESTS OF EYE-PREFERENCE

(N=86)

| Test | Hole-in-Card | Sighting | Aiming |
|---|---|---|---|
| Manuscope | .59±.05 | .44±.06 | .45±.05 |
| Hole-in-Card | | .46±.06 | .46±.06 |
| Sighting | | | .71±.04 |

prove to be statistically reliable; and (2) the existence of a 'unitary' trait of eye-preference as such is not indicated. The latter finding may be interpreted to mean that a whole battery, not a single example of eye-preference tests, is necessary to determine which is the eye most likely to be preferred. As previously mentioned, clinicians and experimentalists who have determined eye-preference by a single test or very few tests should take into account the fact that no one test is sufficient to show various degrees of preference. It may be that eye-preference, as hand-preference, is better defined in terms of the number of activities for which an eye is preferred.

[8] T. L. Kelley, *Interpretation of Educational Measurements*, 1927, 210-211.

# MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF CORNELL UNIVERSITY

## LXXXIV. Gustatory Adaptation to Salt

By Harry Abrahams, Daniel Krakauer, and Karl M. Dallenbach

Though partial adaptation in taste under general stimulation[1] and complete adaptation under local stimulation[2] have been definitely established, attempts at producing complete adaptation under general stimulation, particularly with taste-solutions of strong concentration, have led to negative results.

Finkenbinder,[3] for example, in 1912, made such an attempt with strong solutions of common salt. His method required holding a mouthful of the solution until it was diluted by the flow of saliva, then ejecting it and taking another mouthful, and so on for 8 hours. At the end of that interval, all the *O*s were still able to detect the taste of salt in a fresh mouthful of the solution. These negative results, as we believe, followed from Finkenbinder's failure to provide a constant and unvarying stimulus—the *sina qua non* of complete adaptation. Intensity of stimulation in his experiment dropped from a maximum to a low value as the flow of saliva diluted the solution in *O*'s mouth, and to a still lower value when *O* emptied his mouth preparatory to taking a fresh, full-strength supply. Under those varying conditions it is not surprising that the presence of salt was detected whenever a new mouthful of the solution was taken.

Under proper conditions, with constant and unvarying stimuli, taste may, like vision, prove completely adaptable under general as well as local stimulation. On the other hand, taste may behave like the temperature senses,[4] and adapt

* Accepted for publication June 1, 1934. The publication of this study has been delayed so that it would appear with the companion study which follows.

[1] Partial adaptation, *i.e.* 'dulling' or 'blunting,' is a matter of common observation. For example: saltiness of a broth, the sourness of a fruit, or the sweetness of a preserve fade rapidly with continued eating. Victor Urbantschitsch (*Beobachtungen über Anomalien des Geschmacks*, 1876, 23 f.) was the first to mention the phenomenon of taste-exhaustion. His observations have been quantified within recent years by B. Mayer (Messende Untersuchungen über die Umstimmung des Geschmackswerkzeugs, *Zsch. f. Sinnesphysiol.*, 58, 1927, 133-152) and Erich Hennies (Über die Beeinflussung der Mischungsgleichungen durch Umstimmung des Geschmackswerkzeuges, *ibid.*, 64, 1933, 115-125), who worked with 10 ccm. of solution in the mouth, and by Helmut Hahn (Die Adaptation des Geschmacksinnes, *ibid.*, 65, 1934, 105-145), who restricted stimulation to an area 1.5 cm. in diam. on the surface of the tongue.

[2] Fredrich Kiesow (Schmeckversuche an einzelnen Papillen, *Philos. Stud.*, 14, 1898, 591-615; Expériences gustatives sur diverses papilles insolément, *Arch. ital de biol.*, 30, 1898, 399-425) stimulated single isolated papillae with taste-solutions of various concentrations and found that complete adaptation resulted.

[3] An unpublished study performed by E. O. Finkenbinder in the Psychological Laboratory of Clark University.

[4] Results of experiments on adaptation in the thermal senses reveals that punctiform and areal temperatures close to physiological zero adapt completely, *i.e.* become indifferent. Areal temperatures differing greatly from physiological zero do not, however, adapt completely; partial adaptation, in the sense of blunting or dulling, occurs rather rapidly, but thermal indifference is not reached even after hours of

completely under local stimulation and under weak general stimulation, but not under strong general stimulation. There is no *a priori* reason why we should expect one result rather than the other. We cannot argue from analogy with the other senses because in this instance analogy works both ways. The facts of experiment must be allowed to settle the issue.

The present study was, therefore, undertaken. We wished to discover (1) the character of adaptation to a strong NaCl-solution that was of constant and unvarying intensity. When it became apparent that complete adaptation was to be realized under those conditions, we extended the scope of the study and sought to determine (2) the functional relationship between adaptation-time and stimulus-intensity.

We chose salt rather than some other taste because of Finkenbinder's example and also because we thought that salt would be the least likely to yield complete adaptation.

## Method and Procedure

*Apparatus.* To bring a constant and unvarying strength of solution to *O*'s mouth, we devised the gustatory stimulator shown in Fig. 1.[5] The mouthpiece of this

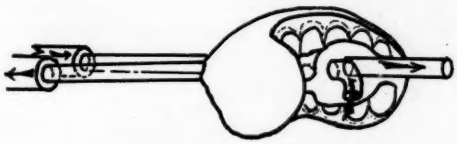


Fig. 1. Gustatory Stimulator

instrument is made of dental impression compound, a thermoplastic wax rigid at mouth temperatures but soft and pliable at slightly higher temperatures. A glass intake-tube carries the solution to the back of the mouth. From there the solution flows forward along the sides and over the surface of the tongue to the drain-tube (also of glass) which is bent downward and opens beneath the tongue. Separate stimulators were provided for every *O*.

The solution, heated to a temperature slightly above that of the mouth (37°-39°C.), was placed in a Mariotte bottle[6] which stood upon a shelf about 5 ft. above *O*. By means of rubber tubes leading from bottle to stimulator to sink, the solution was siphoned through *O*'s mouth. The rate of flow was regulated by means of Hofmann pinchcocks placed on the rubber tubes, and was adjusted so that *O*'s mouth was full and his cheeks slightly distended. A constant amount and strength of solution was thereby delivered to and maintained in *O*'s mouth.

---

stimulation. (See K. M. Dallenbach, Somesthesis, in Boring, Langfeld and Weld's *Psychology,* 1935, 171. The following studies on thermal adaptation have appeared since the acceptance of this one: Solomon Aronoff and K. M. Dallenbach, Adaptation of warm spots under continuous and intermittent stimulation, this Journal, 48, 1936, 485-490; H. A. Levine and K. M. Dallenbach, Adaptation of cold spots under continuous and intermittent stimulation, *idem,* 490-497; W. L. Jenkins, Adaptation in isolated cold spots, *ibid.,* 49, 1937, 1-22. For a bibliography of the earlier studies, see references cited by Aronoff and Dallenbach, *op. cit.,* 485, footnote 1.)

[5] For a description, see Dallenbach, Some gustatory apparatus, this Journal, 48, 1936, 504 ff.

[6] See E. L. McMarthy, Mariotte's bottle, *Science,* 80, 1934, (no. 2065), 100.

*Observers.* The *Os*, 7 in number, included 3 undergraduates who were untrained in observation and who worked without knowledge: Edmund Blau (*B*), William Goldman (*G*), and Samuel Mendelevitz (*M*); J. D. Coakley (*C*), a graduate assistant in psychology and a trained *O;* the senior author (*D*), who served only in the preliminary and corollary experiments, and was the only *O* with experience in the observation of taste; and *A* and *K*, the junior authors, who acted both as *O* and *E*.

*Instructions.* At the beginning of every experimental period, after the stimulator had been rinsed and placed in *O*'s mouth, the following instructions were read to him:

> At a ready-now signal, a salt solution will be introduced into your mouth. [At the signal, *E* removed a Mohr pinchcock from the intake line.] Hold your tongue and cheeks as motionless as possible. Describe the temporal course of your experience, giving particular attention to intensive changes. Signal by raising your right arm if and when the taste of salt disappears.

*Procedure.* The experiments were conducted in the evening, from one to two hours after the *Os* had eaten their evening meal. On account of the prolonged after-effects of the stimulation, no *O* was put through more than one experiment in an evening. From one to three or four days elapsed between successive experiments with the same *O*. Disappearance of the taste of salt under concentrated observation was our criterion of adaptation. Time was measured with a stopwatch.

The stimulus-concentrations used in this study varied by 50-gm. steps from 50 gm. of NaCl per 1000 ccm. of water to 250 gm. as follows:

| Solution | Grams NaCl per 1000 ccm. water | Concentration | |
|---|---|---|---|
| | | % gm. | Mol. |
| 1 | 50 | 4.76 | 0.84 |
| 2 | 100 | 9.09 | 1.66 |
| 3 | 150 | 13.04 | 2.44 |
| 4 | 200 | 16.66 | 3.11 |
| 5 | 250 | 20.00 | 3.93 |

Solution 5 was used only with *D* and *K* in the preliminary experiments. When these *Os* reported complete adaptation with this solution, showing that complete adaptation could be realized under our conditions, we turned to the second phase of our problem—the functional relationship between adaptation-time and stimulus-intensity,—applying the other four solutions (Solutions 1-4) in haphazard order.

## Results

*(1) Adaptation.* Complete adaptation was attained by all the *Os* with all the solutions. The typical course of adaptation was a gradual and continuous intensive decline. Beginning at a maximum which varied with the concentration used, the taste became less and less intense and finally disappeared altogether. Except in the case of the weakest solution, the process was, however, partially obscured by concomitant pains that appeared shortly after the taste of salt and grew more intense and insistent as the experiment progressed. None of the *Os* (except *G*), however, had any great difficulty in abstracting pain from the total experience and in holding their reports to the taste of salt. In *G*'s case, the taste of salt seems

to have been obliterated in great part by the accompanying pain; the taste disappeared abruptly, and its disappearance was closely correlated with the onset of pain. Moreover, adaptation-times are, as shown below, approximately equal for all the stimulus-concentrations. His results, therefore, have not been included with those of the other *O*s, as we believe that we were not dealing in his case with true sensory adaptation.

The other *O*s also reported occasional deviations from the typical course of adaptation. At times adaptation was discontinuous instead of gradual, its course being interrupted, particularly near the end, by sudden intensive increases.[1] Because these intensive increases were sudden and appeared most frequently near the end

TABLE I

ADAPTATION-TIME (IN SEC.) IN EVERY EXPERIMENT WITH EVERY *O*

| *O* | Solution | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| A | 5 | 70 | 40 | 111 |
| | 10 | 72 | 63 | 149 |
| | — | 100 | 78 | — |
| B | 10 | 60 | 58 | 164 |
| | 12 | 69 | 162 | 80 |
| C | 26 | 31 | 50 | 90 |
| G* | 23 | 20 | 23 | 32 |
| | 30 | 28 | 33 | 24 |
| K | 15 | 50 | 60 | 85 |
| | 20 | 51 | 95 | 109 |
| | 30 | 140 | — | — |
| W | 18 | 90 | 209 | 137 |
| Av. | 16.2 | 73.3 | 90.5 | 115.6 |
| m.v. | 6.3 | 22.0 | 43.2 | 25.8 |

* *G*'s data were not included in the computation of the averages.

of the adaptation-period—when *O*'s efforts to keep his tongue and cheeks immobile were least likely to be successful,—we are of the opinion that they are artifactual and that the experiments in which they occur are atypical. These sudden increases are due, as we believe, to the involuntary movements of the tongue which bring certain otherwise inaccessible papillae and taste buds into stimulation; for example, the papillae at the places where the tongue comes into contact with the teeth and the stimulator. If this is the case, a movement of the tongue would, after adaptation had followed its usual course, suddenly bring the unstimulated papillae into function

[1] Similar in this respect to the adaptation-curves of cold and warmth. See Elof Gertz, Psychophysische Untersuchungen über die Adaptation im Gebiet der Temperatursinne und über ihren Einfluss auf die Reiz- und Unterschiedsschwellen, *Zsch. f. Sinnesphysiol.*, 52, 1921, 111. Gertz's results have recently been corroborated by Levine and Dallenbach, *op. cit.*, 493, and by Aronoff and Dallenbach, *op. cit.*, 489.

and a sudden increase in intensity would be experienced. Again, with a given position of the tongue tissue-contacts within the tongue itself may be such that only certain taste buds in a papilla are accessible to stimulation. If this be true,

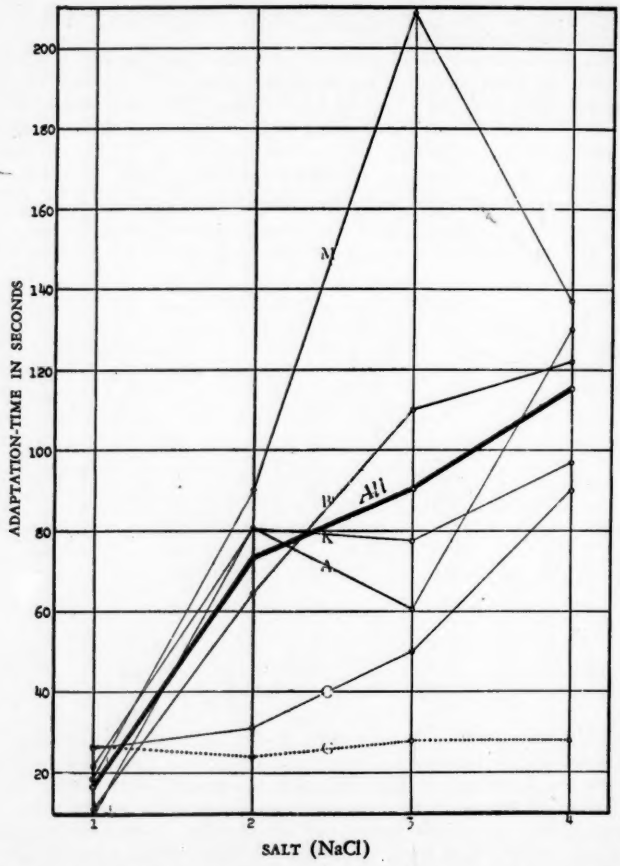



FIG. 2. CURVES SHOWING THE RELATIONSHIP BETWEEN STIMULUS-CONCENTRATION AND ADAPTATION-TIME

a movement of the tongue which changed the tissue contacts would bring other taste buds into stimulation and a sudden increase in intensity would again be experienced. A constant and unvarying solution in the mouth does not necessarily guarantee effective stimulation of all the taste end-organs.

*(2) Adaptation-time.* Table I gives the adaptation-times in every experiment with every *O* and (with *G*'s results, for reasons mentioned above, excluded) the general averages and m.v. for every solution. The relationship between stimulus-concentration and adaptation-time is graphically shown in Fig. 2, with light-line curves for the individual *O*s and a heavy-line curve for the group as a whole.

The adaptation-times with Solution 1 are relatively short for all *O*s, varying from 5–30 sec. The times become longer with Solution 2—slightly for *C* but markedly for *A, B, K,* and *M*—and again longer for all the *O*s with Solution 4. For these three solutions, adaptation-time varies directly with concentration.

The results with Solution 3 are ambiguous. For two *O*s (*C* and *B*) they are consistent with the other results: the adaptation-times are intermediate between those with Solutions 2 and 4. Of the three remaining *O*s, two (*A* and *K*) adapt to it more quickly than to Solution 2; and one (*M*) adapts to it more slowly than to Solution 4.

We are unable to account for the discrepancy in our results with Solution 3. It may be due to the meagerness of our data: two *O* (*C* and *M*) had only one trial with every solution, and no *O* had more than three trials. If an *O* should involuntarily move his tongue in one experiment more than in another and thus bring, as suggested above, unstimulated papillae and taste buds into function, the adaptation-time would be prolonged—irregularities are very apt to appear when few trials are made. With more trials, however, the irregularities would be canceled out, as in the general average for all the *O*s. While the meagerness of our data is admitted, it does not entirely account for the fact that all of our discrepancies appear at one point. It is possible that, with Solution 3, pain first began to play a prominent and distracting rôle. With weaker solutions the pain was less effective (it did not appear at all with Solution 1), and with Solution 4 the salt taste may have been insistent enough to overcome the distraction of the concomitant pain. Whatever the final explanation may be in this particular, our results indicate that in general adaptation-time increases with the strength of the solution.

*G*'s results, shown in italics in Table I and in the dotted-line curve in Fig. 2, stand in marked contrast to this generalization. His adaptation-times are approximately the same with all 4 solutions; his curve in Fig. 2 is almost a straight horizontal line. Excepting perhaps the painless solution (Solution 1), in which *G*'s results are very like those of the other *O*s, we are not, as we believe, dealing in his case with true sensory adaptation. We are inclined to attribute his results to distraction, or to a shift of observation to the more insistent and compelling pain; the taste of the stronger salt-solutions was submerged or obliterated by the pain aroused by them. Because of *G*'s level of observational training, we are unable to throw any light upon this point by reference to his reports. He signalled, as he says, "as soon as the taste of salt disappeared," but whether the disappearance was by way of adaptation or distraction we can only guess. Our best judgment is, since his results do not fall into line with those of the other *O*s, that it was by way of distraction.

*(3) Adaptation vs. distraction.* To test whether the explanation offered for the 'disappearance' of taste in *G*'s case was also applicable to the 'disappearances' reported by the other *O*s, we performed a few corollary experiments in which the solution was allowed to flow through *O*'s mouth until the pain itself completely adapted. If the taste of salt had not truly adapted, but had merely been submerged

by the concomitant pain, then the taste of salt should return and remain behind as a residual experience when pain itself disappeared.

Presenting the three stronger solutions in haphazard order, we made two trials with *A*, *B*, *G*, and *K*. After intervals varying from 8–12 min., two of the *O*s (*B* and *G*) reported complete adaptation to pain with Solution 2. In neither case did the taste of salt return.[8] *A* and *K*, however, were unable to obtain complete pain-adaptation within the time-limits, 12 min., that we used with them. After noting the emergence of pain and the gradual decline and final disappearance of the salt taste, they reported that the pain declined and almost disappeared but that there was still "some tenderness" (*A*), or "a slight pain" (*K*) at the tip of the tongue. With longer stimulation-times, complete adaptation of pain might have resulted. Since the object of the experiment had been attained, however, we spared our *O*s, for whom the experience was becoming extremely disagreeable. The pain remaining at the end of stimulation was so slight and weak that it could not have masked a residual salt if such existed. That the taste did not reëmerge, though the *O*s were attentively primed for it, is further evidence for the conclusion that complete adaptation to salt occurs under general stimulation.

*(4) After-effects.* After signalling that the taste of salt had disappeared, *O* removed the stimulator and ejected the solution from his mouth. Invariably and almost immediately the taste of salt reappeared in its full intensity and persisted thereafter for some time, in many instances from 20–30 min. Its reappearance does not mean that *O* was mistaken in his report, nor does its persistence indicate a long positive after-sensation in taste. On the contrary, these facts imply new and repeated stimulation.

Clearing the mouth, even rinsing and washing it, does not remove all traces of the stimulus. Small amounts remain in the interstices of the teeth and gums, and in the furrows, pits, and pores of the tongue. When the tongue is moved, and its sensitive edges come into contact with the teeth, stimulation may be renewed by the interstitial traces. More important, however, is the restimulation which comes from the tongue itself. Movement of the tongue changes the shape and size of its interstices: this furrow is broadened, that one is narrowed; this pit is deepened, that one is shortened; this pore is opened, that one is closed. In consequence of these changes, the stimulus-solution remaining within these small interstitial spaces is forced into new parts, which its surface tension prevented it from reaching before, and comes into contact with taste buds that had not previously been stimulated. The taste of salt is, consequently, rearoused. The process of adaptation begins again under the new distribution of the stimulus-solution; but before it has time to progress very far, the position of *O*'s tongue is changed again, a new distribution of the stimulus-solution is effected, and another group of taste buds, made up of new or of new and partially recovered buds, is stimulated. This sequence will continue as long as traces of the stimulus-solution remain in the interstices of *O*'s tongue.

---

[8] If we are correct in ascribing the disappearance of the taste of salt in *G*'s case to masking by pain, then we must further assume that true adaptation to the taste of the salt-solution occurred while he was adapting to the pain aroused by it. However that may be, our point here is that true adaptation to salt occurs under general stimulation. *G*'s results strengthen rather than weaken that conclusion.

SUMMARY

In an endeavor to learn whether complete taste-adaptation was possible under general stimulation we devised a method of bringing a constant and unvarying stimulus-solution to *O*'s mouth. Using solutions of common household salt, varying in strength from 0.84–3.93 mol., we obtained the following results.

*(1)* All of the stimulus-solutions, except the weakest (0.84 mol.), arouses pain as well as taste.

*(2)* The taste of salt, at all stimulus-concentrations, typically declines gradually in intensity and finally disappears.

*(3)* Constancy of stimulation is not guaranteed by the presence of a constant and unvarying stimulus-solution in *O*'s mouth. It depends also upon the constancy of the tissue-relationships. Slight and involuntary movements of the tongue may bring taste-organs previously sheltered into stimulation.

*(4)* The disappearance of the taste quality, though in some instances considerably influenced by the onset of pain, is due to adaptation.

*(5)* In general, adaptation-time varies with the concentration of the stimulus-solution: the stronger the solution, the longer the time.

*(6)* The after-effects, which last for intervals of 20–30 min., are not positive after-sensations of the preceding stimulation. They reflect, rather, new and repeated stimulations coming from the traces of the stimulus-solution remaining in the interstices of the tongue and other tissues of the mouth.

## LXXXV. Gustatory Adaptation to Sweet, Sour, and Bitter

By Daniel Krakauer and Karl M. Dallenbach

Since complete adaptation for the taste of salt under general stimulation was obtained in the study reported above, we decided to continue the work and to duplicate that experiment with the other taste qualities. We wished specifically to determine whether sweet, sour, and bitter would also adapt completely under general stimulation; and, if so, to discover how adaptation-time was affected by stimulus-concentration.

### Method

The apparatus and procedure were the same as used in the earlier study, and the stimulus-solutions were again siphoned through *O*'s mouth.

*Stimulus-solutions.* Sweet, sour, and bitter stimulus-solutions were used. All were warmed by an electrical heater to temperatures varying from 39°-41°C. Since the solutions cooled as they passed down the intake-tube, they were approximately body-temperature when they reached *O*'s mouth.

The sweet solutions were made with cane sugar. Five strengths were used: 1%, 2%, 4%, 8%, and 16% of a concentrated solution. The number of grams of sugar per

* Accepted for publication December 3, 1935.

1000 ccm. of water required for their preparation is shown in Table I. This table in addition gives for every solution the percentage of sugar in grams and its molar concentration.

For the sour, we used solutions of tartaric acid, and for the bitter, solutions of quinine hydrochloride. Three strengths were prepared of each: a weak, a moderately strong, and a strong solution. Table I shows the amounts of each substance used in the preparation of every solution and the gram-percentages and the molar concentrations of every one.

TABLE I

SHOWING FOR EVERY STIMULUS-SOLUTION THE GRAMS USED PER 1000 CCM., AND THE GRAM-PERCENTAGE AND MOLAR CONCENTRATIONS

| Stimulus | Solution no. | Grams per 1000 ccm. water | Concentration | |
|---|---|---|---|---|
| | | | % gm. | mol. |
| Sweet (cane sugar, $C_{12}H_{22}O_{11}$) | 1 | 24 | 2.3 | 0.066 |
| | 2 | 47 | 4.5 | 0.131 |
| | 3 | 95 | 8.7 | 0.246 |
| | 4 | 190 | 16.0 | 0.737 |
| | 5 | 380 | 27.5 | 1.260 |
| Sour (tartaric acid, $C_4H_6O_6$) | 1 | 0.33 | 0.033 | 0.0022 |
| | 2 | 1.00 | 0.099 | 0.0066 |
| | 3 | 2.00 | 0.199 | 0.013 |
| Bitter (quinine hydrochloride, $C_{20}H_{24}O_2N_2 \cdot HCl$) | 1 | 0.05 | 0.0049 | 0.000013 |
| | 2 | 0.15 | 0.0149 | 0.000041 |
| | 3 | 0.30 | 0.0299 | 0.000083 |

*Observers: (1) With sweet.* The *O*s for the experiments with sweet were Miss Barabara Edes *(Ed)*, a graduate student in psychology, Mr. Sidney Shapiro *(Sh)*, a senior undergraduate majoring in psychology, and *K* and *D*, the junior and senior authors respectively of this study. Of these 4 *O*s only *K* and *D*, who had served in the experiments with salt reported above, were experienced in the observation of taste.

*(2) With sour and bitter.* Three of the *O*s from the experiments with sweet (*D*, *Ed*, and *K*) and Mr. Albert D. Freiberg *(F)*, a graduate student in psychology and a trained *O*, served in the experiment with sour and bitter.

*K* was the experimenter in all of the observations, in his own as well as in those with the other *O*s.

*Instructions.* The instructions, except for the substitution of the word "sweet," "sour," or "bitter" for "salt," were the same as used in the earlier study,[1] for all the *O*s but *D*. *D*'s instructions were varied slightly for experimental purposes. He was told not to 'hold his tongue as motionless as possible' but to "keep it moving during the entire course of all the experiments."

*Procedure: (1) With Sweet.* The experiments with sweet were performed during the first semester of the university-year 1934-1935. The trials were conducted at noon, from 12 to 1 o'clock—before luncheon for *Ed* and *K*, and after luncheon for

[1] *Supra*, 464.

TABLE II

AVERAGE ADAPTATION-TIME (IN SEC.) FOR EVERY *O* TO SWEET

| O | | Sweet Solution | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| *D* | Av. | 80.3 | 138.8 | 212.4 | 318.8 | 556.2 |
| | m.v. | 8.2 | 27.4 | 31.9 | 43.2 | 105.5 |
| | m.v./av. | 10.2% | 19.7% | 15.0% | 13.9% | 18.9% |
| *Ed* | Av. | 45.3 | 78.0 | 97.0 | 145.0 | 309.6 |
| | m.v. | 15.1 | 34.8 | 49.2 | 79.6 | 60.3 |
| | m.v./av. | 33.3% | 44.6% | 50.7% | 54.2% | 19.5% |
| *K* | Av. | 38.3 | 52.2 | 79.6 | 100.6 | 124.0 |
| | m.v. | 14.3 | 11.4 | 17.0 | 31.5 | 21.2 |
| | m.v./av. | 37.3% | 21.8% | 21.5% | 31.3% | 17.1% |
| *Sh* | Av. | 22.0 | 92.8 | 139.8 | 206.6 | 312.0 |
| | m.v. | 5.3 | 23.8 | 81.8 | 17.9 | 92.0 |
| | m.v./av. | 24.1% | 25.6% | 58.5% | 8.7% | 29.5% |
| All | Av. | 46.5 | 90.5 | 132.2 | 193.1 | 326.0 |
| | m.v. | 22.1 | 36.8 | 70.8 | 80.6 | 74.7 |
| | m.v./av. | 47.5% | 40.6% | 53.6% | 41.7% | 22.9% |

TABLE III

AVERAGE ADAPTATION-TIME (IN SEC.) FOR EVERY *O* TO SOUR AND TO BITTER

| O | | Sour solution | | | Bitter solution | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1 | 2 | 3 |
| *D* | Av. | 85.0 | 265.0 | 287.5 | 112.5 | 167.5 | 187.5 |
| | m.v. | 50.0 | 55.0 | 12.5 | 42.5 | 7.5 | 2.5 |
| | m.v./av. | 58.8% | 20.7% | 4.4% | 37.7% | 4.5% | 1.3% |
| *Ed* | Av. | 83.5 | 116.4 | 135.5 | 38.9 | 66.2 | 122.0 |
| | m.v. | 62.0 | 63.4 | 49.8 | 24.3 | 20.7 | 79.2 |
| | m.v./av. | 74.2% | 54.5% | 36.8% | 62.5% | 31.3% | 64.9% |
| *F* | Av. | 38.3 | 159.0 | 185.0 | 112.3 | 125.0 | 131.6 |
| | m.v. | 17.8 | 6.0 | 16.6 | 11.8 | 5.0 | 25.6 |
| | m.v./av. | 46.5% | 3.8% | 8.9% | 10.5% | 4.0% | 19.4% |
| *K* | Av. | 92.2 | 85.8 | 208.3 | 79.2 | 158.0 | 179.0 |
| | m.v. | 28.6 | 22.5 | 73.3 | 15.8 | 80.5 | 69.2 |
| | m.v./av. | 31.0% | 26.2% | 35.2% | 19.9% | 50.9% | 38.7% |
| All | Av. | 78.6 | 129.6 | 194.8 | 74.7 | 115.3 | 115.6 |
| | m.v. | 46.1 | 63.2 | 66.8 | 34.3 | 52.9 | 68.4 |
| | m.v./av. | 58.7% | 48.6% | 34.3% | 45.9% | 45.8% | 45.1% |

*Sh. D* does not eat at noon so his experiments also fall in the category "before luncheon." But one trial was run at an observational period, and from 1 to 3 or 4 days elapsed between successive experiments with the same *O*. Every *O* was given 5 trials with every one of the 5 sweet solutions.

*(2) With sour and bitter.* The experiments with sour and bitter were run during the second semester of the same university-year. The observations were obtained, to suit the *O*s' convenience, at irregular hours during the day, but always at times varying from one to two hours before or after eating. As in the case with the experiments with sweet, from 1 to 3 or 4 days intervened between successive trials with the same *O*.

At every observational period, one experiment was conducted with sour and one with bitter. Solutions of similar strength were always paired (a weak sour and a weak bitter, a moderate sour and a moderate bitter, a strong sour and a strong bitter) and used in alternating order at different observational periods. If a sour was used first at this period, a bitter was used first at the next.

After an *O* had adapted to the first solution, he rinsed out his mouth and waited from 20-30 min. before taking the second solution. From 2 (for *D*) to 5-6 (for *Ed*, *F*, and *K*) trials were run with every sour and bitter solution.

Disappearance of the taste of the solution under concentrated attention was our criterion of adaptation. Time was measured to the nearest second by a stop watch.

## Results

*(1) Adaptation.* Sweet, sour, and bitter came to complete adaptation in every experiment with every O at every stimulus-concentration used. Table II gives the average adaptation-times, the m.v., and the percentage of variation for every *O* with every one of the sweet solutions, and Table III gives those values for every *O* with every one of the sour and the bitter solutions.

Sweet, sour, and bitter, like salt, come to complete adaptation gradually under general stimulation. From a maximal intensity, which varies with the strength of solution used, the taste of all of these qualities becomes typically weaker and weaker and finally disappears.

Deviations from the typical course of adaptation were occasionally reported by all the *O*s with all three tastes—as in the case of salt. At times adaptation was discontinuous, its normal course being interrupted by sudden intensive increases. These occasions occurred most frequently near the end of the adaptation-period when the fatigue of holding the tongue and other tissues of the mouth motionless was the greatest. We are consequently of the opinion that the intensive increases are artifactual and we believe, furthermore, that they are due to the involuntary movements which bring previously inaccessible taste-organs into stimulation. This conclusion is substantiated by the fact that *D*, who kept his tongue in motion during stimulation, reported fewer aberrant cases of adaptation than any of the other *O*s who held their "tongues as motionless as possible;" and also by the fact that *D* was able to correlate all of his aberrant cases with new stimulations at the back of the mouth that were occasioned by the swallowing reflex.

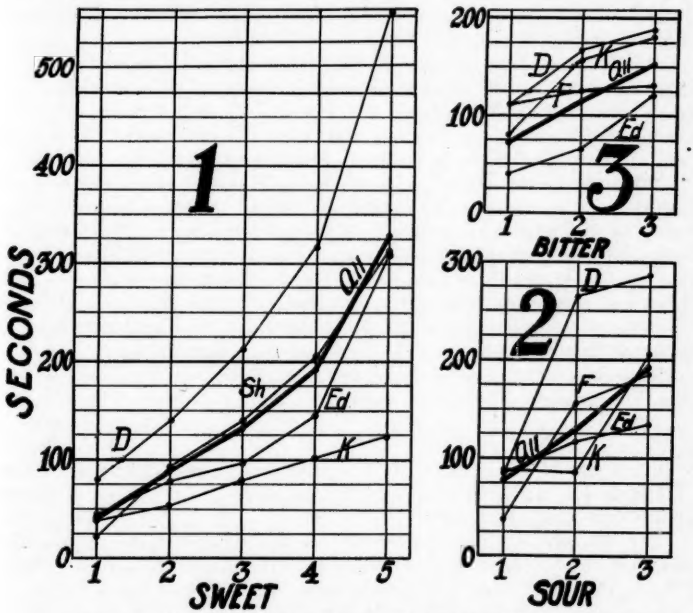
The results of the experiments with sweet, sour, and bitter solutions confirms those obtained with salt. They show (1) that complete adaptation to taste is possible under general stimulation; and (2) that constancy of stimulation is not guaranteed by the presence of a constant and unvarying stimulus-solution in *O*'s mouth.

*(2) Adaptation-time.* As Tables II and III show, adaptation-time for sweet, sour, and bitter varies directly with stimulus-concentration. The stronger the stimulus-

solutions the longer is the time required for complete adaptation. The relation between stimulus-concentration and adaptation-time is graphically shown in Fig. 1 for sweet, in Fig. 2 for sour, and in Fig. 3 for bitter.

The results of the experiments with sweet and bitter are uniform for all the *O*s: adaptation-time increases with the strength of the stimulus-concentration. The same relationship holds for 3 *O*s with the sour solutions, but one *O* (*K*) gives an average adaptation-time that is slightly shorter for Solution 2 than for Solution 1—85.8 sec. as against 92.2 sec. (each value being the average of 6 trials). Beyond the fact that *K* found the experiments with sour particularly unpleasant we have no explanation of the discrepancy in his results.

*(3) After-effects.* All the *O*s reported pronounced after-effects with all the




FIGS. 1-3. THE RELATIONSHIP BETWEEN STIMULUS-CONCENTRATION AND ADAPTATION-TIME

stimulus-solutions. When the stimulator was removed and the remaining solution was ejected from *O*'s mouth, the taste invariably and immediately reappeared at its full intensity and persisted thereafter for some time. The duration of the after-effects was shortest for sweet, of intermediate length for sour, and longest for bitter.

Our experience with the after-effects of sweet, sour, and bitter lead us to the conclusion drawn in the study with salt;[2] namely, that the after-effects of taste are not

[2] *Supra*, 468.

positive after-sensations of the preceding stimulations but are rather the results of new and repeated simulations arising from the traces of the stimulus-solutions remaining in the interstices of the tongue and other tissues of the mouth.

*(4) General observations.* The experiments with sweet were the simplest that we performed in this study. They were pleasant and agreeable to the *O*s and adaptation ran its course with fewer complications than with either of the other solutions used in this study or with salt. The experiments with bitter were more complex. The *O*s found it difficult, particularly with the weakest bitter (Solution 1), to determine definitely when complete adaptation had been realized. This was due, as we believe, to the fact that the root of the tongue, the area most sensitive to bitter, was not stimulated in our method of procedure. In irregating the mouth-cavity only the front part of the tongue was bathed with the bitter solution, hence our *O*s were observing and reporting upon experiences that were aroused from areas that were relatively insensitive to bitter.

The experiments with sour were the most disagreeable and complex of this study. They approached in both of these respects the experiments made with salt in the study reported above. The strongest sour (Solution 3) aroused pain and "set the teeth on edge," made them "feel long" and "gritty"; and the weakest (Solution 1) was frequently perceived as merely astringent and puckery.

When the quinine solutions were used first, the taste of bitter often remained in the mouth, in spite of rinsing and the long rest periods between the stimulations, when the sour solutions were being used. The taste of bitter was, however, easily abstracted from and it did not seriously affect, if it affected at all, the observations in the experiments with sour. When sour, on the other hand, was used first the after-effect was more serious. The solutions of tartaric acid had a slight anesthetic effect upon the tongue which rendered the experiments with bitter more difficult from the point of view of the observer. The adaptation-times, however, were of the same order whether the bitter experiments preceded or followed the sour. They were consequently grouped and considered together.

## Summary

The results of this study, in which we sought to discover whether sweet, sour, and bitter were subject to complete adaptation under general stimulation, may be briefly summarized as follows.

*(1)* The taste of various concentrations of cane sugar, of tartaric acid, and of quinine hydrochloride was completely adapted under general stimulation.

*(2)* The typical course of adaptation for all three of the stimulus-solutions is a gradual intensive decline and disappearance.

*(3)* Adaptation-time for sweet, sour, and bitter varies with the concentration of the stimulus-solution: the stronger the solution the longer the time required for complete adaptation.

*(4)* Constancy of stimulation is not guaranteed by the presence of a constant and unvarying stimulus-solution in *O*'s mouth. Slight movements of *O*'s tongue may, because they change the tissue-relations, bring taste-organs previously concealed into stimulation. Regular movements of the tongue during the entire course of the experiment are more consistent with constant stimulation than the accidental and involuntary

movements that are made when *O* is constrained to hold his tongue and other tissues of the mouth motionless.

*(5)* Pronounced after-effects occur with all the stimulus-solutions. They are shortest for sweet, of intermediate length for sour, and longest for bitter. They are not positive after-sensations of the preceding stimulations, but are the results of new and repeated stimulations arising from the traces of the stimulus-solutions remaining in the mouth.

## APPARATUS

### A NEW PURSUIT-METER

By G. L. FREEMAN and C. R. OLDROYD, Northwestern University

Although recognized as excellent tests of eye-hand coördination, pursuit skills present many difficulties in the way of recording and measurement. The pursuit-meter described here maintains constant stimulus-movements and permits easy scoring of

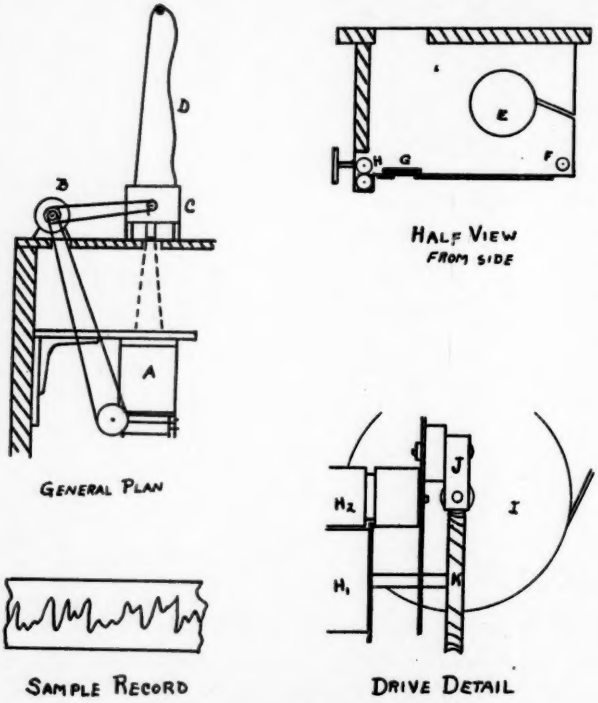



FIG. 1. DETAILS OF THE PURSUIT-METER

the responses. It consists, in essential, of an apparatus for projecting the movement of an animated dot from a film strip upon a ground glass plate over which paper is moved at a constant rate. *S* sits or lies below the instrument and follows the stimulus movement with his pencil. In the figure, the general plan shows the

equipment arranged for use in a shielded booth. The pursuit-meter (A) is hung from the wall and is operated by the motor (B), located above the booth. The motor also operates the toy movie projector (C). The loop of film (D) runs through the projector and over a glass rod suspended from the ceiling. The projector is arranged directly above the pursuit-meter so that the image of the animated dot may be appropriately focussed. The half-view drawing shows certain internal arrangements in the pursuit-meter. Six-inch white wrapping paper from the supply roll (E) is threaded around a roller (F), under the ground glass plate (G), and between the rollers (H) which provide for its traction. The detail drawing gives an enlarged view of these last rollers and their operating mechanism. Roller $H_1$ carries a cog with sharp pointed teeth that prick through the part of the paper passing over the groove in roller $H_2$. The drive wheel (I) is connected with a worm gear (J) which engages the cog wheel (K) attached to roller $H_1$.

The stimulus-pattern is made by moving a black ink dot (placed upon a cellophane strip) back and forth in front of a white card and photographing the excursions with a 16 mm. movie camera. The dot may be held stationary prior to beginning the pattern so as to provide a point of initial reference. By using positive film, the projected image will become a white dot on a black background. The 'key' or stimulus-record is made by threading a strip of insurance bromide paper through the pursuit-meter and photographing the movements of the projected dot of light. In scoring, the tracing of *S* is placed over this key for comparison. Stimulus patterns varying in rate and extent of movement can be easily made. It is well to be supplied with several duplicate film strips of each movement as any resplicing of the original strip will alter the pattern.

## A FOOD-UNIT MEASURING DEVICE

By WILLIAM E. WALTON, University of Nebraska

The amount of food given the white rat on each trial of an experiment and the manner in which he eats it will determine to a large extent the number of trials which he runs. Some animals may seize large mouthfuls of food on one trial and a small amount on the next trial. Furthermore, there is a tendency for all rats to decrease the amount of food taken per trial as the experimental period progresses. In any event, the rate of decrease in the influence of hunger as a motivating factor is not constant. Therefore, an instrument was devised for measuring the amount of food given per trial. It consists of a hollow tube (see Fig. 1) 3/16 in. inside diameter, in

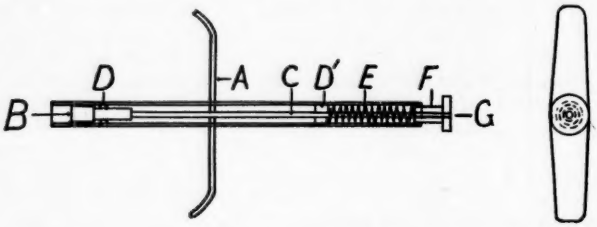



FIG. 1. DETAIL DRAWING OF THE FOOD-UNIT MEASURING DEVICE

which a plunger (B) is inserted. Stops at (D) prevent the plunger from moving upward in the cylinder. Another stop (D') holds spring (E) in place and exerts an upward pressure against the plunger. The shaft (C) connects with a guide (F) and thumb-button (G). A finger guide (A) enables one to steady the apparatus and employ one hand while using it. The lower end of the cylinder is slightly sharpened to facilitate its cutting into the food. In using the device, a standard grain diet is moistened by the addition of either water or milk to a mash consistency and then flattened out to a slightly more than 3/16 in. depth. This food is taken to the experimental room on a board, and there the pellets, 3/16 in. in diameter and 3/16 in. in height, are cut out as each trial is run. The main advantages of the instrument are: first, increased speed in the running of trials; secondly, a minimum amount of handling of the food and therefore greater cleanliness; and thirdly, a better control of the rate of decrease in the influence of hunger as a motivating factor.

# NOTES AND DISCUSSIONS

## Electro-Physiological Methods and Their Use in the Investigation of Growth and Development

The present paper aims to provide a brief survey of the methods of electro-physiology and to consider their possible value in the investigation of problems of growth and development.[1] Our discussion will revolve about the following questions: (1) What are the electro-physiological methods which are available? (2) Why may these methods be of value in the investigation of problems of growth and development? (3) What work has already been done in the developmental field by means of these methods? (4) What special precautions are necessary in their use? In this survey of the electro-physiological methods, one particular field of work, that concerned with the electric potentials of the brain, will be considered in somewhat greater detail than the others.

*Methods.* The methods of electro-physiology may be classified under three headings: (1) methods for investigation of potential difference; (2) methods for investigation of the so-called passive properties of electrical systems; namely, resistance, capacity, impedance, and phase-angle; and (3) methods for measurement of tissue excitability.

These methods may, in principle, be used with any tissue or organ, and under various physiological conditions. Many of the techniques are applicable to the intact organism, and may therefore be used in research upon developmental changes in the human being. Although many problems of a developmental sort may be most fruitfully investigated with animals, the present report will be concerned especially with the use of electro-physiological methods with intact humans.

*Value.* There are some indications from animal experiments that electrical factors help to determine the course of development and differentiation of the organism. To the extent that this doctrine is correct, electrical factors will need to be investigated in arriving at an understanding of how development of the organism comes about. Reports bearing upon this thesis have been made by Kappers, Lillie, Child, Burr, and others.[2] Studies in this field will, however, in the nature of the problem, be confined largely to the use of animal material.

Aside from the possibility just mentioned, electro-physiological methods have no special value in the developmental field which is not possessed by any method

[1] Presented at the meeting of the Society for Research in Child Development at Washington, D.C., November 30, 1936.

[2] H. S. Burr, An electro-dynamic theory of development suggested by studies of proliferation rates in the brain of amblystoma, *J. Comp. Neurol.*, 56, 1932, 347-371; H. S. Burr and F. S. C. Northrop, The electro-dynamic theory of life, *Quart. Rev. Biol.*, 10, 1935, 322-333; H. S. Burr and C. I. Hovland, Bio-electric potential gradients in the chick, *Yale J. Biol. & Med.*, 9, 1937, 247-258; C. M. Child, *Physiological Foundations of Behavior*, 1924; C. M. Child, *Origin and Development of the Nervous System from a Physiological Viewpoint*, 1921; L. H. Hyman and A. W. Bellamy, Studies on the correlation between metabolic gradients, electrical gradients, and galvanotaxis, *Biol. Bull.*, 43, 1922, 313-347; S. Ingvar, Reaction of cells to the galvanic current in tissue cultures, *Proc. Soc. Exper. & Med.*, 17, 1919-1920, 198; C. U. A. Kappers, On structural laws in the nervous system: The principles of neurobiotaxis, *Brain*, 44, 1921, 125-149; R. Lillie, *Photoplasmic Action and Nervous Action*, 1932; S. Tashiro, *A Chemical Sign of Life*, 1917, 62.

throwing light on important physiological phenomena. Any characteristic of the organism may be investigated from the developmental point of view. To the extent that the various electro-physiological methods provide information about important physiological phenomena, it becomes desirable that these methods be used in the investigation of the developmental side of the phenomena in question.

*Previous use.* Although electro-physiological techniques have found fairly wide use in studies upon intact human adults, relatively little use has been made of them in the developmental field. We may consider first the methods used for detection of fluctuations of potential in different types of tissue. The extensive clinical use of the *electrocardiogram* has led to an appreciable number of studies of its characteristics in infancy and childhood.[3] The *electromyographic* technique has been used in a few studies.[4] Travis used it to investigate the relation of reflex times and conduction rates to intelligence. Hazard has applied the same technique to investigation of the relation of reflex conduction rate to chronological age. Despite an extensive literature on the *electrical phenomena of the skin* of humans, relatively little has been reported on the changes in these phenomena with development. Erb, Westphal, Richter, and Jones have reported upon the level of skin resistance in infancy; Peiper, Jones, Wechsler, Aveling, and Porter upon the galvanic skin reflex in infants and children.[5]

In the measurement of *tissue excitability* we find a like disproportion between the extent of the literature on adult humans and on children.[6] Studies upon children

[3] For a review of work on the electrocardiogram of normal infants and children see *Growth and Development of the Child (White House Conference) Part II. Anatomy and Physiology,* 1933, 306-318. Following are some representative investigations in this field.

E. Burghard and A. Wunnerlich, Das Elektrokardiogram des Säuglings, des Neugeborenen und des Frühgeborenen, *Zsch. f. Kinderhk.,* 45, 1928, 56-67; E. B. Krumbhaar and H. H. Jenks, Electrocardiographic studies in normal infants and children, *Heart,* 6, 1917, 189-196; E. M. Lincoln and G. B. H. Nicolson, The hearts of normal children—electrocardiographic records, *Amer. J. Dis. Children,* 35, 1928, 1001-1020; C. B. Perry, The electrocardiogram of normal school children, *Arch. Dis. Child.,* 6, 1931, 259-264; M. Seham, The electrocardiogram in normal children, *Amer. J. Dis. Children,* 21, 1921, 247-281.

[4] C. Hazard, The relation of reflex conduction rate in the patellar reflex to age in human beings, *Univ. Iowa Studies in Child Welfare,* 12, 1936, 181-197; L. E. Travis and F. A. Hunter, The relation between intelligence and reflex conduction rate, *J. Exper. Psychol.,* 11, 1928, 342-354; L. E. Travis and C. W. Young, The relations of electromyographically measured reflex times in the patellar and achilles reflexes to certain physical measurements and to intelligence, *J. Gen. Psychol.,* 3, 1930, 374-400.

[5] F. Aveling, The psychogalvanic phenomenon, *Proc. Int. Cong. Psychol.,* 9, 1929, 63-65; H. E. Jones, The galvanic skin reflex in infancy, *Child Development,* 1, 1930, 108-110; C. Landis, Electrical phenomena of the skin, *Psychol. Bull.,* 29, 1932, 693-752; A. Peiper, Untersuchungen über den galvanischen Hautreflex in Kinderalter, *Jahrb. f. Kinderhk.,* 107, 1924, 139-150; J. P. Porter and H. A. Copeland, Association and psychogalvanic response during early adolescence, *Proc. Int. Cong. Psychol.,* 9, 1929, 349-350; C. P. Richter, High electrical resistance of skin of new born infants and its significance, *Amer. J. Dis. Children,* 40, 1930, 18-26; D. Wechsler, L. M. Crabbs and R. G. Freeman, Galvanic responses of pre-school children, *Ped. Sem.,* 38, 1930, 203-222; A. Westphal, Die electrischen Erregbarkeitsverhältnisse des peripherischen Nervensystems des Menschen im jugendlichen Zustand, *Arch. f. Psychiatr.,* 26, 1894, 1-98.

[6] S. Banu, Recherches physiologique sur le developpement neuromusculaire chez l'homme et l'animal, *These Sc.,* 1922; G. Bourguinon, *La chronaxie chez l'homme,*

by means of the older quasi-quantitative methods of electrical examination have been made by Patrici, Westphal, and Minkowski. More satisfactory quantitative techniques for measurement of tissue excitability have been made possible through improvements in the procedures for precise control of the various properties of the electrical current which determine its effectiveness as a stimulus: properties such as form, magnitude, and duration of single pulses of direct current: and frequency, amplitude, and wave-form of alternating currents.

Among the quantitative procedures, the chronaxy technique has been used by a number of workers in developmental studies. This technique is based on the idea of using particular parameters to represent the characteristics of the strength-duration curve. Reports by Bourguinon, Banu, and Marinesco on changes in motor chronaxies in the course of development indicate that at early stages of development motor chronaxies are appreciably higher than at later stages. The relation of Binet mental age and the chronaxy of subordination has been investigated by Kreezer and Bradway.

A field of research which has developed rapidly in recent years is that concerned with the electric potentials of the human brain (electroencephalogram). Reports concerning bioelectrical potentials in the living brain appeared as early as 1875, and intermittently since that date until recently: for example, Caton (1875), Setschenow (1881), Gotch and Horsley (1889), Beck (1890). Beginning in 1929, Berger reported a series of studies upon the potentials of brain origin which could be detected from the heads of intact human subjects.

Stimulated by Berger's work, a number of men have undertaken the investigation of the characteristics and conditions of the human electroencephalogram.[7] The

---

1923, 226; H. Davis and A. Forbes, Chronaxie, *Physiol. Rev.*, 36, 1936, 407-441; G. Kreezer and K. P. Bradway, Relation between Binet mental age and motor chronaxia, *Arch. Neurol. & Psychiat.*, 34, 1935, 1149-1171; M. Minkowski, Über die elektrische Erregbarkeit der fötalen Muskulatur, *Schweiz. Arch. f. Neurol. u. Psychiat.*, 22, 1928, 64-72; Patrici and Mensi *La Pediatria*, 1893 (cited by W. M. Feldman, *Principles of Ante-Natal and Post-Natal Child Physiology*, 1920, 352); H. Quincke and J. Stein, Chronaxie, *Ergebnisse der Physiol.*, 34, 1932, 907-1064; A. Westphal, *op. cit.*

[7] For review of early work upon the electrical potentials of the brain see M. H. Fischer, *Elektrobiologische Erscheinungen an der Hirnrinde*, 230, 1932, 161-178. For recent symposia on this topic see Symposium on Action Potentials of the Brain, American Medical Association, May 1936, in *Archives of Neurology and Psychiatry*, 36, 1936, 1206-1250; and Symposium on Excitation Phenomena, *Cold Spring Harbor Symposia on Quantitative Biology*, 4, 1936, 267-346. Recent work upon human brain potentials is represented by the following references. E. D. Adrian and K. Yamagiwa, The origin of the Berger rhythm, *Brain*, 58, 1935, 323-351; H. Berger, Über des Electrenenkephalogram des Menschen, *Arch. f. Psychiat.*, 87, 1929, 527-570; 94. 1931, 16-60; 97, 1932, 6-26; 98, 1932, 231-254; 99, 1933, 555-574; 100, 1933, 301-320; 101, 1933, 452-469; 102, 1934, 538-557; 103, 1935, 444-456; 104, 1936, 678-689; H. Davis and P. A. Davis, The action potentials of the brain in normal persons and in normal states of cerebral activity, *Arch. Neurol. & Psychiat.*, 36, 1936, 1212-1235; F. A. Gibbs, H. Davis and W. G. Lennox, The electro-encephalogram in epilepsy and in conditions of impaired consciousness, *ibid.*, 34, 1935, 1133-1148; H. Hoagland, Pacemakers of human brain waves in normals and in general paretics, *Amer. J. Physiol.*, 116, 1936, 604-615; H. H. Jasper and H. L. Andrews, Human brain rhythms: I. Recording techniques and preliminary results, *J. Gen. Psychol.*, 13, 1936, 98-125; H. H. Jasper and L. Carmichael, Electrical potentials from intact human brain, *Science*, 89, 1935, 51-53; G. Kreezer, The electric potentials of the brain in the mongolian type of mental deficiency, *Psychol. Bull.*, 33, 1936,

electroencephalograms of normal human adults reveal the presence of two principal types of rhythms, the alpha rhythm, occurring at an average frequency of about 10 waves a second, and the beta rhythm, occurring at an average frequency of about 25 waves a second. Exploratory studies of the influence upon the electroencephalogram of a variety of conditions have already been made; for example, anesthesia, sleep, sensory stimulation, temperature, and various pathological conditions.

The dependence of the electric potentials of the brain upon developmental variables has also been investigated by certain of the workers in this field. The most extensive study of the influence of chronological age among normal children has been made by Lindsley; Loomis, Harvey, and Hobart have reported upon the brain-potentials of children during sleep. Davis and Davis have been especially interested in conditions responsible for individual differences. Their study of identical twins indicates that the patterns found in records obtained under standard conditions are a function of inborn conditions of cortical organization. Kreezer has investigated the relation of Binet mental age to the characteristics of the electroencephalogram, and the effects associated with different types of mental deficiency. In the investigation of the influence of mental age, a useful group methodologically has been the Mongolian. No influence of mental age was found down to mental age levels of about 5 yr.;[8] below this level differences of two kinds appear: (1) a marked decrease in prevalence of regular sequences of alpha waves, and (2) the appearance of large waves of long duration, particularly over motor and frontal areas. Tentative theories have been proposed in explanation of a number of the effects referred to above.

Research upon the brain-potentials of animals, important in arriving at physiological explanations of the records obtained with humans, has been going on in a

607; G. Kreezer, The electric potentials of the brain in certain types of the mentally deficient, *Arch. Neurol. & Psychiat.*, 36, 1936, 1206-1213; F. Lemere, The significance of individual differences in the Berger rhythm, *Brain*, 59, 1936, 366-376; D. B. Lindsley, Brain potentials in children and adults, *Science*, 84, 1936, 354 ff; A. Loomis, E. H. Harvey and G. Hobart, Electrical potentials of the human brain, *J. Exper. Psychol.*, 19, 1936, 249-279; J. F. Tönnies, Die unipolare Ableitung elektrischer Spannung von menschlichen Gehirn, *Naturwissen.*, 22, 1934, 411-414; L. E. Travis and J. R. Knott, Brain potentials from normal speakers and stutterers, *J. Psychol.*, 2, 1936, 137-150; W. G. Walter, Location of cerebral tumors by electroencephalography, *Lancet*, 2, 1936, 305-308.

Following are some papers of interest which have appeared since the presentation of this report: B. K. Bagchi, The adaptation and variability of response of the human brain rhythm, *J. Psychol.*, 3, 1937, 463-485; D. B. Lindsley and B. B. Rubenstein, Relationship between brain potentials and some other physiological variables, *Proc. Soc. Exper. Biol. & Med.*, 35, 1937, 558-563; H. Hoagland, M. A. Rubin and D. E. Cameron, Electrical brain waves in schizophrenics during insulin treatments, *J. Psychol.*, 3, 1936, 513-519; G. Kreezer and F. W. Smith, Electrical potentials of the brain in the hereditary type of mental deficiency, *Psych. Bull.*, 34, 1937 (in press); J. R. Smith, The origin and genesis of rhythm in the electro-encephalogram, *Psych. Bull.*, 34, 1937 (in press); E. A. Spiegel, Comparative study of the thalamic, cerebral, and cerebellar potentials, *Amer. J. Physiol.*, 118, 1937, 569-579; L. E. Travis and R. L. Milisen, Brain potentials from the rat, *J. Genet. Psychol.*, 49, 1936, 405-409; L. E. Travis and E. A. Gottoeber, Do brain waves have individuality, *Science*, 84, 1936, 532-533.

[8] Additional data obtained more recently indicate that changes in the electroencephalogram with decreasing mental age may be detected below a mental age of 6 years, in the mongolian group, rather than 5 years as reported initially.

number of laboratories.[9] Of special interest from the developmental point of view is a study by Bridgman, Jasper, and Carmichael upon the development of brain-potentials in the fetal guinea pig.

*Possible artifacts.* In the use of electro-physiological methods, special care must be taken to avoid artifacts which may invalidate the results. The measurement of passive electric properties such as resistance, capacity, and impedance depends on the way a given tissue conducts currents produced by application of electrical pulses or waves of known intensive and temporal properties. Errors may therefore arise from the application of potential differences with properties other than the assumed standard properties and from the presence of tissue-characteristics which interfere with a given type of measurement. In the measurement of tissue excitability, errors may arise from the lack of standard conditions of observation or from the presence of unknown properties in some part of the apparatus or conduction system which results in stimulating currents through the tissues whose characteristics differ from those assumed to be operative. In the recording of bio-electric potentials, possible types of artifact that may appear are: (1) electrical effects originating in external physical sources; (2) introduction of electric potentials produced in some part of the organism other than that being investigated; and (3) distortion of the records of bio-electric potentials by some part of the recording system, or even by the tissue through which electrical effects are conducted to the electrodes. The need for special precautions against the introduction of such artifacts depends in part on the high sensitivity usually required in the measuring devices employed, and in part on the large number of factors capable of influencing electrical measurements.

Training School GEORGE KREEZER
Vineland, N.J.

## THE THIRTY-SECOND ANNUAL MEETING OF THE SOUTHERN SOCIETY FOR PHILOSOPHY AND PSYCHOLOGY

The thirty-second annual meeting of the Southern Society for Philosophy and Psychology was held at the University of South Carolina, Columbia, S.C., on March 26-27, 1937. The Council met on the evening of March 25. Separate philosophy and psychology sessions were held in the morning and in the afternoon of the first day, and a joint session, followed by the business meeting, was held in the morning of the second day. Thirty-four papers were read, 19 in psychology and 15 in philosophy.

The psychology session on the morning of the 26th, under the chairmanship

[9] E. D. Adrian, The spread of activity in the cerebral cortex, *J. Physiol.*, 88, 1936, 127-161; G. H. Bishop and S. H. Bartley, A functional study of the nerve elements of the optic pathway by means of the recorded action currents, *Amer. J. Ophthal.*, 17, 1934, 995-1005; C. S. Bridgman, An ontogenetic study of cerebral action potentials of the guinea pig, *Psychol. Bull.*, 33, 1936, 769-770; J. G. Dusser de Barenne and W. S. McCulloch, Some effects of laminar thermocoagulation upon local action potentials of the cortex of the monkey, *Amer. J. Physiol.*, 114, 1936, 692-694; R. W. Gerard, W. H. Marshall and L. J. Saul, Electrical activity of the cat's brain, *Arch. Neurol. & Psychiat.*, 36, 1936, 675-735; E. L. Gibbs and B. Rempel, The Berger rhythm in cats, *Science*, 84, 1936, 334-335; A. E. Kornmüller, Die bioelektrischen Erscheinungen architektonischer Felder der Grosshirnrinde, *Biol. Rev.*, 1935, 383-426; J. F. Tönnies and A. E. Kornmüller, Ableitung bioelektrische Effekte vom uneröffneten Schädel, *J. Psychol. u. Neurol.*, 45, 1933, 154-184.

of C. P. Heinlein, was devoted principally to papers in experimental psychology. The following titles appeared on the program: The Curve of Forgetting and the Distribution of Practice (Howard Easley); Development of Thought (Buford Johnson); Experimental Studies of Skin Sensitivity to Mechanical and Electrical Vibration (B. von Haller Gilmer); Effects of Asphyxia Block upon Vascular Action and upon Sensitivity to Cold and Warmth (John P. Nafe); An Active Principle in Binocular Interdependence (S. Rains Wallace); The Concepts of Conscious, Subconscious and Unconscious (J. B. Miner); Learning and Retention in Educational Broadcasting (Steuart H. Britt); A Preliminary Report on a Recently Developed Eye-Hand Coördination Test (Joseph E. Moore).

Dr. Buford Johnson presided over the psychology session in the afternoon of the 26th, and the following papers in comparative and experimental psychology were presented: The Varying Function of Affectively Toned Olfactory, Visual and Auditory Cues in Recall (Margaret M. Ratliff); The Effect of Phenobarbital upon the Maze Learning of White Rats Reared upon Rich, Normal, and Vitamin A and Vitamin D Deficient Diets (Clifford T. Morgan and Paul E. Fields); The Effects of Inactivity Produced by Sodium Amytal on the Retention of the Maze Habit in the Albino Rat (R. W. Russell); The Modification of Conditioned Eyelid Responses by Non-reënforced Elicitation (James M. Porter); A Technique for Rapid Conditioning of Animals (Norman L. Munn); Delayed Reaction by An Infant Chimpanzee under Unusual Conditions of Motivation (T. L. McCulloch); Conceptions of Drive, as Urge and as Internal Stimulus, in Relation to the Conditioned Salivary Response to Food and Acid (Karl Zener); An Experimental Evaluation of Patterned Responses (Henry F. Dickenson).

At the philosophy session in the morning of March 26th, W. P. Warren presided and the following papers were read: God and the Cosmos in the Philosophy of Nicholas of Cusa (Anna Forbes Liddell); Definition and Discovery in Plato's "The Sophist" (G. Thomas Preer); Matter in the Plotinic Hierarchy (Laurence F. Kinney); Science and Morals (J. B. Gittler); The Subjective Basis for the Judgment of the Beautiful (Iredell Jenkins); Value in Whitehead's Metaphysics (Lewis M. Hammond); An Examination of Stern's Philosophy (Herbert C. Sanborn).

Dr. Marjorie S. Harris presided over the philosophy session in the afternoon of March 26th, at which 6 papers were presented: The Theory of Types and the "De Ente" (Kenneth K. Berry); Three Levels in the Analysis of the One and the Many in St. Thomas Aquinas (Leonard J. Eslick); Kant's Theory of Intuitus Intellectualis in the Inaugural Dissertation of 1770 (Christopher B. Garnett); The Rôle of Graphical Methods of Analysis in the History of Logic (Charles K. Davenport); A Restatement of the Question of Being (Homer G. Richey); The Refutation of Indeterminacy (Peter A. Carmichael).

The annual banquet was held on Friday evening, March 26th, in the Hotel Columbia, with 85 persons in attendance. After the banquet President McKissick of the University of South Carolina made a brief welcoming address. Following Dr. McKissick's talk, Dr. Lyle H. Lanier delivered the presidential address, entitled "The Descriptive Categories of Psychology."

The session in the morning of March 27th was a joint session, with Dr. Lyle H. Lanier as chairman. Six papers were read, as follows: Statistical Abuses in Experimental Psychology (C. Paul Heinlein); On the Sense of the Finite (Marjorie S. Harris); The Genesis of Action Preferences (G. R. Wendt); Mediaevalism in

Modern Political Thought (Marten ten Hoor); The Elasticity of the Concept "Specific Response" (H. M. Johnson); The Indefensibility of Dictatorship (A. G. A. Balz).

The annual business meeting was held at the conclusion of the joint session. Reports of the Secretary-Treasurer, and recommendations of the Council were presented. Two permanent committees were established, to be called the Committee on Psychology and the Committee on Philosophy. These two committees would, in a sense, continue the work of the two former temporary committees on the teaching of these subjects, but would also consider other matters involving the general academic status of these subjects in the South. The following officers were elected: President, Marten ten Hoor; to the Council, Emily S. Dexter, Marjorie S. Harris, John Paul Nafe. Frank A. Geldard continues as Secretary-Treasurer, the term of this office being three years.

It was voted to accept the invitation of the University of Tennessee to hold the next meeting in Knoxville, Tenn. The date of this meeting will be April 15 and 16, 1938.

Vanderbilt University LYLE H. LANIER

## THE TWELFTH ANNUAL MEETING OF THE MIDWESTERN PSYCHOLOGICAL ASSOCIATION

The Midwestern Psychological Association held its twelfth annual meeting at the University of Illinois, Urbana, Illinois, on Friday and Saturday, May 7 and 8, 1937. About 375 persons registered, of whom 330 were members, representing 20 different states and Canada. The program, which contained 65 formal papers, mainly experimental, was divided into twelve regular sessions, devoted to the following topics: Physiological Psychology, Tests and Measurements, General Psychology, Personality, Electro-physiology, Human and Animal Learning, Sensory Phenomena, Clinical and Social Psychology, Affective Phenomena, and Conditioning. Three of the sessions dealt with physiological problems, in contrast to last year's program in which psychopathology was the popular topic. Beside the regular sessions, one evening was devoted to selected symposia on Personality Measurement, Child Psychology, Transfer in Learning and Forgetting, Motivation, Action-Current Techniques, Social Control, Physiological Aspects of Psychopathology, Theories of Conditioning, and Reorganization of the First Course in Psychology. A special session was held for reports from the laboratories, where research in progress was described by representatives from each institution.

Special events included a tea given by the faculty wives at which about 250 persons were served; a dinner for the Illinois Society of Consulting Psychologists; and a luncheon for the Psi Chi national psychological fraternity.

At the annual business meeting, it was announced that the Association would hold its next annual meeting at the University of Wisconsin, at which time we would help the Wisconsin group to celebrate the 50th anniversary of the founding of their laboratory. It was voted to take the necessary steps to affiliate with the American Psychological Association. It was also voted that, in the future, the annual meeting date would be the week of May 1, or within one week of it, and that it would not be subject to change because of conflict with other organizations. A committee was appointed, with A. R. Gilliland, chairman, to investigate the question of publication of abstracts of program papers in full. There were 53 new members elected, of whom

33 were members or associates of the American Psychological Association. A letter was read by H. B. English explaining the work of the Spanish Relief Committee. The election committee announced the election of A. G. Bills as president of the Association for 1937-38, and of J. P. Guilford as secretary-treasurer for 1937-40. E. S. Conklin was elected council member for 1937-40 and L. E. Travis to complete Guilford's unexpired term, 1937-39.

At the annual banquet, on Saturday evening, about 250 persons were served. Dean Fletcher welcomed the Association on behalf of the University of Illinois. The presidential address was delivered by H. A. Carr on the subject "The Search for Certainty." Taking as his point of departure the prevalent tendency in psychology to apply mathematical formulae for reliability to certain data and problems in which no such application is justifiable, in order to secure a false semblance of scientific profundity, he questioned the whole movement toward substituting mathematical criteria of reliability in place of personal integrity, instrumental precision and care, on which scientific veracity is built.

On the whole, the feeling was prevalent that the current meeting had achieved a high mark both quantitatively and qualitatively.

University of Chicago ARTHUR G. BILLS

## THE EIGHTH ANNUAL SPRING MEETING OF THE EASTERN BRANCH OF THE AMERICAN PSYCHOLOGICAL ASSOCIATION

The Eighth Annual Spring Meeting of the Eastern Branch of the American Psychological Association was held at Vassar College, Poughkeepsie, N.Y., on Saturday, April 3, 1937. The attendance was the largest in the history of the Branch; 360 persons were present; 196 being members and associates, and 164 guests.

The Board of Directors met on Friday evening, April 2, in Poughkeepsie. In connection with the discussion about a change in the manner of nominations and the growth of the Branch indicating a two-day meeting, President Fernberger appointed a Committee composed of Douglas H. Fryer, Chairman; Leonard Carmichael and H. Sherman Oberly to investigate and report definite recommendations to the Directors in regard to nominations of officers and the advisability of two-day meetings. This report is to be made at the 1938 meeting.

At the Business Meeting the following officers were elected: President (1937-1938), K. S. Lashley, Harvard University; Secretary-Treasurer (1937-40), H. S. Oberly, University of Pennsylvania; Directors (1937-40), K. M. Dallenbach, Cornell University, and J. W. Dunlap, Fordham University. Committee members were appointed for as follows: Program Committee, G. W. Hartmann, Teachers College, Chairman, T. W. Forbes, Harvard University, and E. Heidbreder, Wellesley College.

Nominating Committee, T. M. Abel, New York City, Chairman, I. Lorge, Teachers College, and G. Kreezer, Vineland Training School. It was voted to hold the next Annual Spring Meeting at New York University, University Heights, on April 2, 1938.

At both the Directors meeting and the Business meeting keen regret was expressed on the illness of Professor Margaret F. Washburn who had invited the Branch to meet at Vassar College. Upon the motion of Herbert S. Langfeld, the Branch voted to express to Professor Washburn their sympathy and regret upon her illness and her absence from the meeting.

The growth of the Branch made necessary several changes in the By-Laws, among

the most important of which are (1) the broadening of the territory of the Branch to include all "persons who are Members or Associates of the American Psychological Association in good standing and who are located in the Eastern part of the United States or Canada;" (2) the placing of the date of the Annual Meeting "on the first week-end in April;" and (3) the changing of the presidency from an honorary to an active office.

The scientific section of the program comprised the presentation of 61 papers in 9 Sections classified as follows: Conditioned Responses, Sensory Processes, Abnormal Psychology, Attitudes, Learning and Memory, Brain Processes, Comparative Psychology, Psychometrics, Applied Psychology. An innovation in the program was made so that the papers were scheduled on a time basis, in this way it was possible to know the precise time at which each paper would start. This change seemed to meet with considerable success.

The Department of Psychology at Vassar College proved themselves to be ideal hosts and much credit is due them for the excellent facilities provided for the meeting.

A luncheon, attended by 174 people, was held at Alumnæ House, at which time the Branch was cordially welcomed by Dr. Henry Noble MacCracken, President of Vassar College. The Presidential Address entitled "A Psychological Cycle" was delivered by Samuel W. Fernberger.

Lafayette College HERBERT W. ROGERS

## THE NORTHAMPTON MEETING OF THE SOCIETY OF EXPERIMENTAL PSYCHOLOGISTS

The thirty-third annual meeting of The Society of Experimental Psychologists, the first since the Society's incorporation, was held on March 25 and 26 at Smith College, Northampton, Mass. It was attended by 25 members from 16 institutions—the largest attendance and widest representation of the Society since its reorganization in 1929.

After a short business session, informal reports of work in progress were received from the following institutions and men: Brown (Graham and Hunter); Chicago (Klüver); Columbia (Woodworth); Cornell (Dallenbach and Weld); Harvard (Beebe-Center, Boring, Lashley, and Pratt); Illinois (Culler); New School for Social Research (Wertheimer); New York State Psychiatric Institute (Landis); North Carolina (Dashiell); Pennsylvania (Fernberger); Princeton (Bray, Langfeld, Wever); Rochester (Carmichael); Stanford (Hilgard); Smith (Koffka, chairman); Swarthmore (Köhler); Yale (Hull, Jacobsen, Miles).

At a dinner given to the Society by Smith College on the evening of the first day of the meeting, Dean Marjorie H. Nicolson extended the College's welcome and greetings. After a response by the Chairman of the Society, Professor Kurt Koffka, the Howard Crosby Warren medal for outstanding research in experimental psychology was presented to Professor Karl Spencer Lashley of Harvard University "for his distinguished work on the physiological basis of learning and on the neural mechanisms involved in vision."

The next annual meeting of the Society is to be held at the University of North Carolina, Chapel Hill, N.C., on Thursday and Friday, April 7-8, 1938. Professor John F. Dashiell of the University of North Carolina was elected chairman of the Society for the coming year. K. M. D.

## Edward Stevens Robinson: 1893–1937

Professor Edward S. Robinson of Yale University was born on April 18, 1893, at Lebanon, Ohio. The psychological world was shocked and grieved to hear of his accidental death on February 27, 1937. He was struck by a bicyclist while crossing the street in front of the Graduate School Quadrangle at Yale. He was carrying a large parcel of manuscript, and apparently stepped back into the path of the bicycle in avoiding an oncoming automobile. Thrown to the pavement, he suffered a severe brain concussion, and was immediately removed to the New Haven Hospital, where he died three days later without recovering consciousness. A public memorial service was held on March 1st at Marquandt Chapel.

Robinson secured his public school education in a suburb of Cincinnati, and then entered the University of Cincinnati, from which he was graduated in 1916. There he was a leader among the students and was highly regarded by the members of the faculty. He majored in psychology and at once made a favorable impression upon Professor B. B. Breese, who encouraged him to continue graduate work in this field.

The next year he spent at Carnegie Institute, where he secured his Master's degree in 1917. During the next three years he had a varied career as a graduate student at Chicago, a member of the trade-test division of the War Department, and an instructor at Yale. He made an excellent record at Chicago, and upon his graduation in 1920 he was appointed as an assistant professor in the department, being promoted to the rank of associate professor three years later. After seven years of service at Chicago, he returned to Yale with the rank of professor.

One of Robinson's outstanding characteristics was the breadth, variety, and versatility of his psychological interests, coupled with his willingness to work diligently and enthusiastically in any field that the occasion demanded. Tests and industrial psychology occupied his time at Carnegie and in the Army. While he never pursued these subjects further, they continued to retain his sympathetic interest. At Chicago, his thesis lay in experimental psychology, and, in response to departmental needs, he devoted his energies to experimental work on learning, fatigue, and mental efficiency. During this time he started the museum work in which he presently became intensely interested. He also was importantly concerned with theoretical and systematic problems, and he was a frequent attendant at the meetings of the Philosophy Club. This systematic interest came to the fore upon his return to Yale, when he published his essay on Association, his two *New Republic* papers, and his later excursion into the field of law and social problems.

Another of Robinson's noteworthy characteristics was his reflective curiosity. He enjoyed playing with ideas—analyzing out their relations and ramifications in an objective fashion. He possessed a spirit of mental adventuresomeness, a desire to enter relatively unexplored fields of thought. These two tendencies were largely responsible for his later development at Yale, a development which was an expression of his fundamental intellectual interests. He could evaluate a system of psychology both from its own and from other points of view, and this objective versatility is in part responsible for his apt phrase-making as illustrated in the *New Republic* articles.

Robinson's activities in psychology were extensive. He was a coöperating editor of this JOURNAL from 1925 until his death; coöperating editor of the *Psychological Bulletin* from 1926-1930 and editor from 1930-1935; treasurer of the American Psychological Association from 1925-1930 and a member of the council from 1935-1937; and vice-president of Section I (Psychology) of the American Association for the Advancement of Science in 1936. In addition to his membership in these Associations he was a member of the Society of Experimental Psychology, the National

Institute of Psychology, and the Eastern Branch of the American Psychological Association. He served on the National Research Council, Division of Anthropology and Psychology, from 1930-1933.

Robinson was genial, affable, and sociable, an interesting and entertaining conversationalist, a person who thoroughly enjoyed his wide circle of friends and acquaintances. He had the ability to discuss controversial questions with those holding diverse views without acrimony or loss of mutual respect. His untimely passing in the prime of life is a loss to psychology and a source of deep regret to his friends.

University of Chicago HARVEY A. CARR

## Edwin Asbury Kirkpatrick: 1862–1937

The death of Edwin Asbury Kirkpatrick on January 4, 1937, takes from the field of psychology one of its most productive men and strongest characters. He was in his seventy-fifth year.

Professor Kirkpatrick spent most of his adult life at the Fitchburg State Teachers College in Massachusetts. This institution was a normal school of the usual pattern when he went into it. He continued his work there until after its transformation into a teachers college.

He was born in Peoria, Iowa, on September 29, 1862. In this state he did his undergraduate work and got his first teaching experience. Taking advantage of the opportunity that was offered in the founding of Clark University, he was among the first students to register in that institution after it was opened. He grasped immediately the spirit of investigation that pervaded the work in Clark, and almost at once learning took on with him the character of original research. It was at Clark that I first came to know him. The characteristics which stand out as most prominent in him are his simplicity, earnestness, and untiring industry.

In a letter his son speaks of him as one of the first settlers in the domain of psychology, and suggests that he enjoyed most of all breaking up native prairie soil. Psychology had in his day to create its own methods, and, while some of its work was crude, nevertheless it took on the character of discovery. All of the work of Professor Kirkpatrick in his classroom was conducted after the manner of original investigation. He planned simple experiments and carried them out in the classroom. In fact, the students were led along in their studies by the methods of investigation.

Professor Kirkpatrick's first important book was *The Fundamentals of Child Psychology*. This book appeared in 1902, and it underwent successive revision up to 1929. Few books have received as much recognition. His next book of importance was his *Genetic Psychology* which attempted to offer as a textbook an outline of the work in the field of child development. It is perhaps from the standpoint of science a better product than the first, but it has not enjoyed the appreciation nor obtained the wide adoption of the other book. His latest book is his *Mental Hygiene*, which met sharp competition from many others. It is plainly worthy of its author, and gives evidence that the mental health and vigor enjoyed by him was retained up to the time of publication.

The last nine years of Professor Kirkpatrick's life were a bit saddened by his retirement. He had scarcely reached the level of highest maturity and of productive energy when the law forced him to quit teaching. He kept up his spirit, however, and worked with encouragement and enthusiasm almost to the day of his death.

Temple University THADDEUS L. BOLTON

## BOOK REVIEWS

*Elementary General Psychology.* By SAMUEL W. FERNBERGER. New York, F. S. Crofts & Co., 1936. Pp. xi, 445.

This is an introductory text in psychology. There are twenty-two chapters organized into five parts. Part I includes the author's conception of what psychology is and a brief history of its development. The problems discussed in Part II are the simple conscious processes which include the special senses of vision, audition, muscular and kinesthetic sensation, the senses of taste and smell, and the cutaneous, the static and organic senses, and attention which is referred to as "the conditions of clearness." In Part III the complex conscious processes, including memory images, memory, simple and complex, and thinking are treated. Reaction is dealt with in Part IV and this includes a discussion of reflex, instinct, emotion, volition and habit. Motivation and drive, individual differences, and the integrated personality are discussed in Part V.

The author's treatment is based on a dualistic philosophy of mind and matter. He states that the study of consciousness should make an important contribution to the field of psychology and he tries to "explain and relate both conscious processes and reactions" (p. ix). This viewpoint has resulted in a treatment of the problems dealt with in general psychology that is very different from that given in most current texts in the field. For example, tactual localization of points on the skin is explained by the theory of *local sign* which assumes qualitative differences in sensations from different points of origin stimulated. There is no reference to the experimental evidence which indicates that the perception of tactual localization is a learned or integrated process.

Attention is explained in terms of the clearness of different fields of consciousness. Differences in attention in a given individual from time to time and in powers of attention in individuals are due the author says, to four characteristics of attention: "(1) in the relative degrees of clearness between the center and background; (2) in the range or the number of experiences which may be clearly in consciousness at any one time; (3) in the persistence or length of time which any clear part of consciousness may be kept in maximal clearness; and (4) in the alertness or rapidity with which the processes in the clearness center may change" (p. 171). One's success in life, he says, is due to his having a balance of these four characteristics of attention which are congenital; that is, the limits of their development are set at birth. Such a view would seem to indicate some relation between intelligence and attention, but if any is implied there is no reference to it. The discussion is abstract and does not give a clear conception of the relation of attention to perception.

The concept which will no doubt be most generally challenged is that upon which the explanation of reflex reaction, instinctive reaction, and volition is based. The differences among these forms of action are explained in terms of the temporal relation of awareness to reaction. The explanation is as follows: reflex reaction is rarely followed by consciousness, instinctive reaction is usually followed by consciousness, and in volition the awareness precedes the reaction (p. 352). Suggestion and hypnotism are given as the simplest types of reaction classed as volition. The statement that reflex reaction does not result in any connections with higher brain centers except rarely and that instinctive reaction does and is usually accompanied

by a "conscious backstroke" can hardly be accepted as a convincing argument for keeping the concept of instinctive reaction. The detailed discussion of instinctive behavior in animals should be given in a course in comparative instead of in an introductory course in psychology.

All of the drawings and explanations of the physiological structure and functioning of receptors are over-simplified and inadequate. There is no reason, for example, why it would not be as easy for beginning students to learn that the ciliary muscle regulates the focusing of the eye for near and far vision as to learn that, "this change in the shape of the lens is accomplished by the degree of pull or tension on the lens by sets of muscles at its edge" (p. 49). There is no reference to rod and cone cells in the discussion of the functioning of the retina in vision and no attempt to explain the causes of positive and negative after-images. It is difficult to see why color-blindness, visual adaptation, and after-images should be discussed as processes of monocular vision. The drawings of the structures which function in hearing are very inadequate. It is indeed doubtful that such an analogy as the comparison of the cochlea extended to a stuffed sausage could add anything to the clarity of one's conception of its structure. The drawing of the cross-section of the cochlea showing the basilar membrane and the hair-like cells is the poorest in the book. The description of the physiological structure of the nervous system is accurate, but the drawings are incomplete and are usually inadequately labelled. The one drawing in the book which is labelled in detail has the word *precedes* spelled "preceeds" twice.

There are many typographical errors: "there" for "they" (p. 106); "come" for "some" (p. 141); "appreception" for "apperception" (p. 167); etc.

The statement and criticism of the psychoanalytic theory of drive and motivation are very good, but the general discussion of this problem is left rather indefinite and incomplete and does not give a constructive explanation of the rôle of motivation in behavior. Notwithstanding the fact that the treatment of most of the problems dealt with in the text would have to be taught so critically that the result would be confusing to the beginning student, some of the topics are presented very effectively. Some examples of accurate, clear-cut, well-illustrated presentations are the discussions of the laws of color mixture, visual perception, and the processes of audition and thinking.

Georgia State College for Women EURI BELLE BOLTON

*Eugenical Sterilization.* By A. MYERSON, J. B. AYER, T. J. PUTNAM, C. E. KELLER, and L. ALEXANDER. New York, Macmillan Co., 1936. Pp. ix, 211.

This is a report of the Committee for the Investigation of Eugenical Sterilization appointed by the American Neurological Association in 1934. The first part of the book is fact finding. Among the significant facts gathered are the following: (1) twenty-seven of our States have laws permitting eugenical sterilization, but in the main the laws are not being enforced; (2) there is nothing to indicate that mental disease and mental defect are increasing—all that is certain is that hospitalization is increasing; (3) while the constitution that develops epilepsy has possibly some relationship to the constitution that develops dementia praecox, the relationship is not close enough to warrant the postulate of any widespreading unitary trait back of all psychoses, feeblemindedness, epilepsy and the like—the eugenic studies of Lombroso, Moral, Esquirol and others should now be relegated to the history of psychiatry rather than to its activity utilizable material; (4) though dementia praecox occurs in certain families in a higher incidence than in the general population, it

is yet to be proved that the hereditary factor operating is mendelian; (5) manic-depressive psychosis is inheritable in both its mild and severe forms; (6) in a considerable segment of feeblemindedness, heredity plays a rôle of importance, but it cannot be considered as a simple mendelian recessive character; (7) epilepsy occurs more frequently in the descendants of epileptics than in the descendants of non-epileptics, but the vast bulk of epileptics arises from families having a law incidence of epilepsy and who are indistinguishable from the mass of the population; (8) the effort to breed crime out by eugenical measures is, in the present state of our knowledge, not to be recommended and (9) mental disorders in identical twins are very apt to be associated.

In the final chapter the Committee concludes, from its study of the discoverable facts: (1) that our knowledge of human genetics has not the precision nor amplitude to warrant the sterilization of people who themselves are normal in order to prevent the appearance in their descendants of manic-depressive psychosis, dementia praecox, feeblemindedness, epilepsy, criminal conduct, or any of the conditions which we have had under consideration; (2) that there is at present no sound scientific basis for sterilization on account of immorality or character defect; (3) that environmental agencies of life are probably as important as the hereditary.

With these limitations in mind, the Committee recommends that selective sterilization be considered only in the following diseases—arranged in the order in which sterilization appears to be indicated: (1) Huntington's chorea, hereditary optic atrophy, familial cases of Friedrich's ataxia, and certain other disabling degenerative diseases recognized to be hereditary; (2) feeblemindedness of familial type; (3) dementia praecox (schizophrenia); (4) manic-depressive psychosis; (5) epilepsy.

The American Neurological Association is to be congratulated on the publication of this very important report. In a field which is woefully cluttered with the results of researches poorly conceived or badly done, and which has been so frequently the stamping-ground for faddists and reformers, it is a welcome sight to see the modern scientists advancing in orderly lines and with definite plans even though the pace be necessarily slow.

Cornell University D. F. SMILEY

*Primitive Behavior: An Introduction to the Social Sciences.* By WILLIAM I. THOMAS. New York, McGraw-Hill Book Co., 1937. Pp. ix, 847.

Professor Thomas' work is a distinguished and erudite document which illustrates the relevancy of anthropological data to the social sciences.

His method may be characterized in terms of three factors which give a cultural polarity to his psychological treatment: (1) comparative handling of data; (2) a comprehensive sampling of representative diversification in modes of behavior; and (3) a detachment from the ethical, religious, and economic preconceptions of our own culture in evaluating the culture of primitives. The insistence upon (3) would today seem superfluous, and yet it does appear necessary to reaffirm it when a Malinowski grows to be as much concerned with demonstrating a primitive basis for our patrilineal monogamy as was Westermarck in the last century.

Although to some the question of native differences in degrees of mental endowment among 'races' has lost a good deal of its significance, Professor Thomas quite properly devotes to it an entire chapter. It is common knowledge that theories of innate group differences have not been sustained, and that such differences as may

conceivably exist are too insignificant to account for the wide diversification of culture and behavior between groups; but these facts have been insufficient to shake the complacency of 'racially' oriented writers who disguise their chauvinism as science. Professor Thomas adds, what is never unwelcome, a great deal of confirmatory evidence on this point and demonstrates that the specific manifest behavior within a group is not innate but developed from cultural traditions and their related habit systems. These traditions and habit systems, becoming crystallized, are accepted within the group as immutable facts of nature in default of other functionally significant alternatives. To have this point amply documented is of primary importance to social psychology. Here Professor Thomas has been conspicuously effective with an impressive body of anthropological data.

On the related question of cultural change and evolution he is equally sound. Appreciating the influence of the natural environment, he nevertheless stresses the cultural area, which includes group contact through migration, conquest, etc., as the factor in social change and advance to higher levels of civilization, in contrast to the unwarranted views of those that emphasize hereditary potentialities as the primary determinant.

In method he is consistently comparative. As an illustration of his procedure, we may take his scrutiny of the variety of treatment of twins in different groups. His sampling of practices shows, for example, that every conceivable form of behavior may be found. This ranges from the application of extremely sinister policies, to reward, and to indifference in connection with this occasional event. On the one hand there may be, all equally mandatory, the slaying of both children at birth, of either one, of the males only, of the females only, of the mother; there may be ostracism for all; and on the other hand there may be signal honor for the parents. The mother may be entitled permanently to carry the honorific title 'Mother-of-twins,' with a right to special salutation and a double greeting, one for each twin. In another case the father is entitled by virtue of having had twins to collect a fortune in cattle for a period of years out of respect for his magical powers which must be conciliated. The explanation of twins and the consequent attitude of the tribe is based on varied definitions and points of view from group to group, often depending on an acknowledged traditional coincidence of tribal calamity or of good fortune with the advent of a pair of twins sometime in the past.

A little criticism might be offered against Professor Thomas' preference for the rigid concepts of atomic behaviorism (Chap. III), when in passing he alludes to the mechanics of the psychological process by which an infant becomes the product of its culture. The chapter on language is treated philologically and psychologically. Here, too, there is a somewhat too great leaning on mechanism and behaviorism to account for the learned use of language, and little or no regard for the important psychological distinction between attributive language and symbolic language.

Chapter XIII, "Patterns of Distinction," is especially sound and significant to the social psychologist who is interested in the enormous variety of incentives which may initiate behavior. Professor Thomas shows that, once the securing of food, shelter, and a mate, on the basis of accumulated property, is effected, the striving for the expansion of personality assumes a consuming importance and a variety of forms quite wholly detached from the acquisition of property. This, too, is significant to the social psychologists in the task of distinguishing between the merely local external manifestations of incentives and their irreducible fundamentals.

This book is of first rank importance to teachers and advanced students of social psychology. While it is certainly fundamental, it is difficult to concede that it is an 'introduction,' as the subtitle states. Before this work can be used to best advantage, the student would have to become properly oriented in the elementary matters of the discipline. In a style that is clear, graceful, urbane, and always engaging Professor Thomas applies his integrating conception of the primacy of the rôle of culture in the determination of primitive behavior; and by tactful emphasis leads to the inference that this same conception, rather than a principle of innate differences, may best account for characteristic distinctions of civilized behavior.

University of Louisville ELLIS FREEMAN

*The Psychology of the Unadjusted School Child.* By JOHN J. B. MORGAN. Revised edition. New York, Macmillan Co., 1936. Pp. vii, 339.

This is a revised edition of a book appearing originally in 1924. It is written in a popular style for teachers. Its purpose is to help teachers learn to distinguish between healthy and unhealthy behavior and to give aid to children whose behavior is leading them into personal habits of faulty adjustment. The book is interesting, even entertaining. It will help many teachers to a better understanding of themselves and to a better relationship with children, especially with those bearing the label of "unadjusted." Compared with the larger task of fostering a healthful environment for children, or, indeed, of understanding what constitutes a healthful environment, the book fails to make a significant psychological contribution. The author's concepts are loosely expressed and many are basically unsound.

In Chapter V, for example, is the statement: "We can best conceive the real nature of mental struggles by keeping before us the analogy of the ordinary type of warfare." This statement is elaborated for the next several pages (pp. 66 ff.). The book tells us that "the teacher's task is to discover the first signs of a mental struggle in her pupils, see that the nature of the struggle is clearly apparent to the child, and then help the child to win the battle" (p. 68). "In this chapter we wish to stress the need for perspective in planning a campaign. If children are left to themselves they certainly do not have an adequate breadth of knowledge to enable them to select the best weapon to fight their battles; it is the teacher's task to give assistance in analyzing problems and in teaching children how to be more efficient in fighting their mental battles" (p. 69). Psychologically this does not represent much advance in thinking or any great change in technique from the singing of *Onward Christian Soldiers,* which Sunday School teachers have been doing for many ineffective years. It might be maintained with a bit of cogent logic that it has been due to these battling Sunday School teachers, these warfaring parents, not to say crusading psychologists, that much of the obstruction to healthy growth in the child has arisen in the first place. It is consistent with the author's major premises that the "unadjusted child" is one in whom the psychological and social growth processes have been obstructed. Can there be no growth or learning without "victory"? Can there be any growth at all *with* victory? And what is the psychological nature of this victory of the kind related to "the ordinary type of warfare"?

Growth is flexible and yielding. War is deterministic, rigid, relentless, and unyielding. To quote the author's view: "We usually consider the side victorious which yields the less when it comes to a final settlement" (p. 67). Growth is self-abandoning; war is self-preserving. Self-preserving, by definition, cannot be growth, however justifiable it may be in certain situations.

One does not wage war with arithmetic problems or with reading difficulties. Nor has "victory" ever been shown to be a satisfying outcome of social conflict even among children. The solving of a problem as well as the development of an immunity against an erratic or unreasonable parent takes place within the child. The child rearranges *himself*, he changes his own psychological structure or function, so as to see new relationships, new meanings in the difficulty. To the reviewer it would seem that to talk so at length in terms of "victory" and "conquest" even conquest over "objective difficulties" (p. 59) is not only to mislead teachers and others but to miss the point oneself. The aim of the school teacher is not to produce a roomful of victors but to help children utilize their energies for growth and change.

Ambiguities and confusions occur through the lack of clarity in the use of other concepts such as, for example, those of blame and competition. Blame is mentioned in perhaps a dozen or more places outside of Chapter XI, "Blaming Others," and competition is also discussed in several places. On these two concepts of such practical importance to educators and to children and of such theoretical difficulty to psychologists the reader finds only very loose writing.

The book is nicely printed. At the end of each chapter are practical hints for teachers and questions for review. A short list of selected books for further reading and an index are also included at the end. In the bibliography one is inclined to pass over the somewhat chronological error in assigning authorship to the reference for "Mental Conflicts and Misconduct."

University of Illinois HAROLD H. ANDERSON

*Educating for Adjustment.* By HARRY N. RIVLIN. New York, Appleton-Century Co., 1936. Pp. xiv, 419.

The student of mental hygiene of the school child who is seeking a book on that subject which is at once readable, scientific, and comprehensive will not be entirely satisfied with this one, although it does meet the first requirement and approaches the other two. The following quotations suggests the type of book which the author wished to write: "It is difficult to find anywhere else published material offered in the name of serious study that is as sickeningly sentimental as are some of the popular articles on mental hygiene written for teachers" (p. 8). "Much that is written aims at interesting, rather than informing, with too great a portion of anecdotal and subjective literature" (p. 7). "There is a growing body of fact that must be utilized as the basis for mental hygiene in the classroom" (p. 9). The fact that he fell short of accomplishing this represents no peculiar limitation of the author or of this book. It rather illustrates the present state of the field of mental hygiene.

The book proposes to take the point of view of mental hygiene into the classroom. It presents the problems of adjustment in the normal child. Extreme aberrations are seldom mentioned, and then only to illustrate the nature of traits and adjustment mechanisms. The first part of the book exposes the basic features of various explanations of problem behavior: psychoanalytic (Freud, Adler, Jung), psychological (Behavioristic and Gestalt), and psychobiological (Meyer). A second part is devoted to a discussion of factors which condition maladjustment. The longest part of the book is devoted to educational practices which are calculated to foster or prevent proper adjustment. This includes discussion of discipline, incentives, punishment, teachers' attitudes, and teaching techniques.

The treatment of these subjects represents largely what the author regards as true and useful ideas concerning the causes and prevention of maladjustment. With these

ideas the reviewer is in complete agreement, but he still feels the need for a more objective determination of their validity. It is a good book, within the limits of the present state of our knowledge of the subject. "The chief contribution made by mental hygiene is a point of view" (p. 7).

Duke University HOWARD EASLEY

*Accidents and Their Prevention.* By H. M. VERNON. Cambridge, University Press, 1936. Pp. ix, 336.

The subject of accidents and their prevention has received a great deal of attention since the advent of the machine in our civilization. Due to the rapidly mounting number of road accidents and the publicity given to them there has been an increased interest in the study of the various factors concerned in their causation.

In this volume Vernon presents a very comprehensive study of accidents from the standpoint of their occurrence, preventive measures that have been used, and suggestions for reducing the frequency of their occurrence. His own studies dealing with various phases of the problem are well-known. He drew heavily, however, from various sources dealing with accidents in Great Britain as well as the studies of Karl Marbe's in Germany and certain data gathered by different investigators in America. The book deals with accidents of all kinds, in the factory, in mining activities, on the highways and railways, and even in the home. The data relative to the frequency of accidents are in themselves an interesting and valuable source of information.

Concerning the problem of individual differences in susceptibility to accidents Vernon expresses doubt as to whether a battery of tests will ever be developed that will select with a great deal of accuracy those who are accident-prone. Such instruments may be used as a rough selective procedure, but he suggests further that the accident record should be followed and those persons whose record shows a number of accidents over a limited period of time should be transferred to some other occupational task. Accident-proneness is not considered as a definite fixed quality, but on the contrary is likely to vary considerably physiological and mental states or condition.

The two elements present in accidents, the mechanical and psychological, are studied to some degree separately. Vernon recognizes, however, that both of these are entities and in most cases causal ones in an accident situation. "A safety habit of mind" is emphasized as a means of developing habits of work and play that promote safety. The most needed measure appears to be the adoption of safety campaign and increase safety instruction. Concerning this latter need he says: "Instruction should begin in the home almost as soon as the children can walk and talk, and be emphasized when they go to school" (p. 326).

Although he claims that most can be accomplished by attacking the problem from the psychological side he concludes in the last sentences of the volume the following: "Only by combining the two factors to their full capacity can we hope to reduce accidents to a really low level, on the roads, in the home, in factories and elsewhere."

The materials and suggestions presented in this volume should be of special interest and value to safety organizations, law makers, teachers concerned with safety instruction, industrial psychologists as well as others who are especially concerned with the promotion of human welfare and happiness. Vernon has done a splendid and worth while piece of work in bringing these materials to our attention.

University of North Carolina K. C. GARRISON

*Children Handicapped by Cerebral Palsy.* By ELIZABETH EVANS LORD. New York, Commonwealth Fund, 1937. Pp. x, 105.

Although many studies have been made of children handicapped by cerebral birth lesions, no previous report, so far as the reviewer knows, contains psychological examination of so large a group of patients continued for so long a period as this study of Lord's. She summarizes the experience gained from repeated examinations of an unselected group (300) of cerebral palsy cases with varying degrees of mental and physical handicap. Her aim is to make the results of her study available to parents and teachers responsible for the care and training of birth-injured children.

The book is well written, clear, and free from technical terms that might confuse the lay reader. Excerpts from case studies illustrate critical points. The first chapter, a medical explanation by Dr. Bronson Crothers, describes in relatively simple language the results of lesion at various levels in the brain. Its importance for the lay reader lies in the assurance that the lesion is static and not progressive; that once the damage has been done it will not grow worse.

Of special importance to clinical psychologists is the author's critical adaptation of testing materials for use with her subjects. She emphasizes that the intelligence-test score, expressed either as mental age or as predictive index, is quite valueless educationally for many of these patients because the composite score of the standard tests obscure pedagogically significant differences in special abilities and disabilities presumably due in these cases to the brain damage. This is a point many educators, doctors, and psychologists have yet to comprehend.

Throughout her study Lord emphasizes that an adequate testing program, conducted by psychologists who are familiar both with the implications of results and with normal child development, is but the beginning. Educational and parental understanding of the problems involved and coöperation in solving them must be maintained to train the child most advantageously.

Lord mentions the need of a school for the mentally normal birth-injured child. This need could well be elaborated. All too often training is discontinued for these patients after they reach the early 'teens and not much information is available concerning adult adjustment. We need to know more about the possibilities from training and for self-support so we can avoid blind educational programs for children handicapped by cerebral birth palsy.

Cornell University S. GERALDINE LONGWELL

*Healthy Growth.* By MARTHA CRUMPTON HARDY and CAROLYN H. HOEFER. Chicago, University of Chicago Press, 1936. Pp. xii, 360.

It is unfortunate that the extensive longitudinal study reported in this monograph, representing as it does a large expenditure of time and money, should receive such an obscure and confusing presentation. Doubtless the pertinacious reader can sweat out much of value from the 360 pages of text and the 120 tables. He will not find, however, that material which seems to be promised him in the synopsis appearing on the dust-cover; namely "yearly records of health, growth, accomplishment, habits, and social development as the children progressed from the third grade to junior high school." He will find only those records for the first three or four years of this period. He will discover, moreover, that the statement, also appearing on the dust-cover, "Participants in the health-instruction projects . . . showed a higher rate of growth on mental and educational tests" may be literally true but the differences between the health-instructed and control groups are not statistically significant. These

two unfulfilled promises do not help to establish a favorable rapport between the writer and the reader.

In brief, this monograph is an account of a controlled experiment which attempted to demonstrate the influence of four years of classroom and extra-classroom health instruction upon 268 children, who at the initiation of the investigation were about eight years of age and in the low third grade. A control group of 104 children went through the same testing program but received less health instruction. The experimental group was on a distinctly higher intellectual and socio-economic level than the control group at the beginning of the study. This incomparability tends to obscure the real effects of health instruction.

This review will confine itself only to the psychological aspects of the investigation. The gains made by the two groups on the following measures were not significantly different; Stanford-Binet M.A., memory span for digits, free association, the Knox cube-test, three learning tests, the Healy-Whipple tapping test, educational achievement, school success, play and club activities, attendance at movies, reading habits and behavior adjustment. There was a significant difference in favor of the health-instructed group for gains in spelling, and a decrease in interest in music lessons by the health-instructed children.

A contingency coefficient of 0.42 is reported between general health and intelligence. In the light of D. G. Paterson's comments on the spurious nature of most correlations between physique and intellect, this purported relationship should be viewed with skepticism.

For those who are interested in adding to their collection of statistical 'howlers,' the reviewer calls their attention to the table and text on pages 20-21.

It is to be hoped that the writer will be more considerate of the patience of the reader in succeeding reports of later stages of this potentially significant study.

University of Oregon CALVIN S. HALL

*Gesetze des Sehens.* By WOLFGANG METZGER. Frankfurt am Main, W. Kramer & Co., 1936. Pp. xvi, 172.

Dr. Metzger's book is very readable. Intended for non-psychologists, it avoids technical terms and presents its material in any easy, flowing style which holds the reader's interest to the end. It presents the basic phenomena of visual perception in such a manner that what have hitherto been for the most part curiosities of the laboratory can now be understood as essential characteristics of a functioning system. The reviewer knows of no other book on the applied psychology of vision which makes such excellent use of recent laboratory discoveries. The book should be translated into English.

The study of perceptual processes has suffered in recent years from two handicaps. It has (1) led to the investigation of problems and the formulation of principles which seem to have very little connection with practical living; and (2) it has failed to lead to satisfactory explanations. Dr. Metzger's book is an answer to both criticisms. Underlying the first criticism is the assumption that the phenomena of color, form, and movement can be divorced from the life of the functioning organism. These phenomena are, on the contrary, imbedded in the most fundamental reactions of the organism to its surroundings. The familiar phenomena of grouping, of strong and weak configurations, of closure, of form, size, and color constancy, usually demonstrated by means of blackboard and color-wheel, assume new sig-

nificance when they are presented in the context of protective coloration, of the history of painting, of the deciphering of ancient texts, of the perception of the books, pencils, and trees of everyday life. The author has assembled 194 illustrations, ranging from simple line drawings to hieroglyphic reproductions and astronomical photographs in support of his thesis.

Underlying the second criticism is the time-worn assumption that the characteristics of perceptual objects are "secondary" in nature, somehow or other less fundamental than are the functions of sense-organ, nerve and muscle. The arguments against this assumption need not be repeated. Our knowledge of the eye and the brain is too meager to enable us to predict the characteristics of the visual world. In this field the psychologist can formulate problems for the physiologist and the neurologist, but he cannot postpone systematization until these problems are solved. It is possible to formulate psychological laws, Dr. Metzger contends, which can function as the bases for hypothesis, experimentation, and explanation; and it is just such a set of laws that is presented in *Gesetze des Sehens.*

Swarthmore College R. B. MACLEOD

*Practical Examination of Personality and Behavior Disorders: Adults and Children.* By KENNETH E. APPEL and EDWARD A. STRECKER. New York, Macmillan Co., 1936. Pp. xiv, 219.

The book is exactly what the title indicates. The first part is a collection of questionaries and medical blanks to be filled out in connection with the examination, both physical and mental, of the adult psychiatric patient. This is followed by a Part II which gives questionaries and blanks to be filled in connection with the examination of children. The second part is on the order of material usually collected for child guidance clinics.

The book opens with a chapter on the art and practice of psychiatric examination. This should be extremely valuable for careful reading by either the beginning psychologist or psychiatrist or, as far as that goes, social worker, minister, or even the parent. It contains a great deal of wholesome advice by way of approaching a patient, which is excellent and which is frequently omitted in books dealing with psychiatric or psychometric examinations. The chapter closes with this statement, "Learn to be a good listener. If we do this with intelligence, our psychiatric patient will unfold his problems and their development to us. And the evolving of this story is of prime value in psychiatric therapy itself."

Besides blanks and questions on the usual psychiatric history, suggestive questions are offered to bring out emotional conditions, delusions, hallucinations, obsessions, insight, and the general stream of mental activity.

The weakest portion of the book comes about in the brief discussion of association reactions, the ink "blotch" test, and types of personality. All three of these chapters would be of little use to anyone who had not already a thorough knowledge of them from other sources as the accounts in this book are entirely too scanty to be of any aid to the person who is not already sophisticated and well-informed along this line. It is surprising that more was not said about the association-test as it is so basic with those who attempt any analysis from this standpoint. In the ink blotch test, no reference is made either in the bibliography or footnotes to the Rorschach Ink Blot Test, which is the essential background on which most of this work rests.

Part II of the book consists of blanks and questionaries for children, including

the Gesell Tests for little children and the standard Stanford Revision of the Binet Tests. The remaining questionaries deal with the usual problems that we find in various tests on child guidance, such as obedience, temper tantrums, enuresis, jealousy, fears, lying, stealing, masturbation, and convulsions.

The bibliography is peculiarly incomplete and gives very little recognition to either original articles or the critical background of the literature on which the various questionaries have been based. The book, however, is a handy compilation and should be of considerable practical aid to psychiatrists and psychologists, but except for the excellent discussion on the art and practice of psychiatric examination in the first chapter is uncritical.

—University of Pittsburgh W. T. ROOT

*Testing Children's Development.* By CHARLOTTE BUEHLER and HILDEGARD HETZER et al. Trans. by HENRY BEAUMONT. New York, Farrar & Rinehart, 1935. Pp. 191.

This volume makes significant contribution to the growing literature on infant development through presentation of the carefully developed testing system of Charlotte Buehler and her associates. The first half of the book discusses theoretical implications of the testing movement, and the basis of construction of "The Viennese Tests," while the latter half, which is freely illustrated, is devoted to the description of the test items.

The authors list six categories which include all the fundamental characteristics of human behavior; namely, (1) sense perception, (2) bodily movements, (3) social behavior, (4) learning, (5) manipulation of materials, and (6) mental productivity. They then make a systematic selection and construction of test items based on these categories which cover the essential steps of development and give a cross-section of the child's personality at every stage. From observation of modes of behavior characteristic of each stage of development they have chosen ten items which they consider symptomatic and suitable for a test situation at every age-level.

The tests for the different years are presented by different collaborators, those for the first year (ten series) by Liselotte Frankl and Kaethe Wolf; for the second year (three series) by Irmgard Gindl and Ludwig Koller: for the third to fifth years (one series per year) by Maria Maudry; and for the sixth year (one series) by Lotte Danzinger.

A developmental chart accompanying the book shows the arrangement of the separate test items according to the various categories at every age-level, and provides the basis for graphic presentation of the test results on the profile form. In addition to its value for the clinician this chart is of interest also because of theoretical implications for the field of child development.

Those who use the tests will be grateful for the listing of necessary materials, the examples of scoring, and the convenient arrangement of the material, but will regret the lack of more detailed discussion of many of the separate test items, even though the concise presentation strictly adhered to by the authors has much to recommend it.

An excellent chapter on "The Technique of Testing," which stresses the requirements of "functional similarity" rather than "objective identity" of test situations, is particularly well presented and merits the thoughtful consideration of every clinical psychologist. A bibliography of 349 titles includes many studies published in Ger-

many, and also covers the more important American work in the pre-school and testing fields. An index would add to the book's usefulness.

Letchworth Village, Thiells, N.Y. ELAINE F. KINDER

*Cares for Minds in Distress.* By MORRIS LICHTENSTEIN. New York, Jewish Science Publ. Co., 1936. Pp. viii, 345.

Symptoms of the commoner functional psychoses and minor disorders are simplified from psychiatric descriptions, and followed by discussions of medical, psychoanalytic, and religious therapies for each disorder. Medical treatment is regarded as valuable in physical disorders, but limited in mental cases. Psychoanalysis is briefly explained but adjudged doubtful or even harmful. The religious treatment described consists of very simple prayers, usually in highly symbolic imagery, *e.g.* in hysterical paralysis "first the vision of fiery rays is directed toward the brain and sympathetic nervous system, destroying all the perverse mental contents responsible for the physical condition. Then the rays are directed to the disturbed limb or organ, destroying the painful or abnormal condition. After this the prayer takes the form of a visualized stream of health . . . succeeded by a prayer for cheer, and then the patient is visualized in a perfect state."

The results from the first group of cases reported are unconvincing because the author was dealing with manic-depressives, long known to be susceptible to spontaneous (though temporary) recovery. Claims on other disorders are more vague, except for a final chapter on minor disturbances. Students of the psychology of religion will probably find the religious point of view too limited for an adequate treatment of possibilities in the field. Faith in the Divine Power is considered all important, but faith healing is believed to be gradual rather than miraculous. Clinicians will note the neglect of control data or alternative psychological interpretations of religious phenomena, a crucial omission in this uncertain field.

Northwestern University ROBERT H. SEASHORE

*Keeping Your Child Normal: Suggestions for Parents, Teachers and Physicians; with a Critical Estimate of the Influence of Psychoanalysis.* By BERNARD SACHS. New York, Paul B. Hoeber, 1936. Pp. 142.

This small volume, previously published under the title of *The Normal Child,* is a curious mixture of common-sense advice on matters of child-rearing and violent denunciations of the theories of Freud. Either type of material would be more effectively presented without the admixture of the other. Much of the book sounds like echoes from an earlier day. We read such statements as: "Child Study has been strangely perverted . . . undue importance has been attached to this question of sex. . . . I have known mothers who were misled and made unhappy by the salacious doctrines of the Austrian school. . . . Almost invariably the problems of sex education engross the attention of mothers at their regular (club) meetings." Such remarks certainly are not true of the major part of this country today. The teacher will be pleased with the author's commendation of much of her work, but will wonder why no mention is made of the present day emphasis on social habits and social training. The parent will agree with such statements as "to give pleasure to others cannot be inculcated too early" but will wonder why the reason should be in terms of self-interest, saying that "Sister Mary will like you so much better for doing this for her." The psychologist will be interested in the arguments against the acceptance

of Freud, but will be amazed at the contrasting of child psychology and common sense and at the implication that the majority of psychologists, particularly the "old-fashioned" ones, recommend psychoanalysis for everyone. While there is much of sane counsel in the book, the readers who will benefit most from its perusal are not the broad group of "seriously minded mothers," (the only ones the author "hopes or cares to reach") but rather those seriously minded mothers who have become extremely interested in psychoanalysis.

University of Minnesota JOSEPHINE C. FOSTER

*Readings in Mental Hygiene.* By E. R. GROVES and P. BLANCHARD. New York, Henry Holt & Co., 1936. Pp. xii, 596.

This volume is intended as a source book for use in courses in mental hygiene. It is planned to accompany the *Introduction to Mental Hygiene* by the same authors, and must be considered in this light. The book is a series of selected writings which aim to cover the entire field. They are essentially modern, and, save in a few instances, were originally published not earlier than 1930. The authors quoted are well chosen, and are the chief figures of present-day work in mental hygiene. The selections are carefully classified, so as to give the reader a rather comprehensive view of the various backgrounds, aspects, and applications of the subject in an orderly sequence. One must expect, of course, that the selection of material for a source book, no less than the writing of an original text, will show the bias and interests of the authors. One notes in this book, therefore, the rather considerable emphasis upon psychoanalysis. This emphasis is probably no more marked here than elsewhere in current orthopsychiatric literature, but it is definitely present. Some of the selections would be liable to prove difficult reading for a student in an elementary course, even with a background of academic psychology. When this obstacle is surmounted, he would find available a wide panorama of current thinking in mental hygiene. The authors have performed a worth-while service in bringing this material together within a single volume, one which deserves a place in the library of any student of human problems.

Milwaukee County Mental Hygiene Clinic GILBERT J. RICH

*The Concept of Time.* By LOUISE ROBINSON HEATH. Chicago, University of Chicago Press, 1936. Pp. xiv, 236.

This work consists primarily of a critical and analytic but well integrated review of the comments on time of a half hundred or more philosophers, taken in historical succession from Zeno to contemporary writers. In the discussion of the modern period, attention is given to the concept of time as it occurs in the various sciences, especially physics. Probably the average reader would have been helped to a better understanding of the numerous references to space-time, relativity, and the quantum theory if the writer had somewhere given an exposition of these concepts, and explained more definitely how the definition of time is related to the quantum theory. Purely psychological problems concerning the perception and judgment of time are expressly avoided. By way of conclusion, a distinction is made in terms of operational definitions between several concepts of time, particularly the physical, the mathematical, and one identified with what Boodin calls the "Principle of Negativity."

University of Illinois HERBERT WOODROW

*Abnormal Personality and Time.* By NATHAN ISRAELI. New York, Science Press Printing Co., 1936. Pp. 123.

Dr. Israeli, employing the interrogatory method, examined a number of variously classified mental patients in an attempt to discover their attitudes toward time and to achieve some correlation between their attitudes and the nature of the disorder. If this study indicates any results they are effectively obscured. Much of the book consists in irrelevant illustrative materials and case histories, an analysis and a history of the problem; and an entire section is devoted to a discussion of one patient's system for beating the bank at Monte Carlo. The author's proposed 'future autobiography' technique—a method whereby written reports on their possible personal futures are obtained from patients and examined for clinical significance—is no more reliable than most questionaries. Furthermore, the entire study must be rated low on a validity scale since any generalizations are forced to depend on subjective reports from incompetent individuals. Finally, the intention in the title is not realized for Dr. Israeli seems to be concerned primarily with the future and only incidently with time.

Cornell University ROBERT M. LINDNER

*Les Trois de l'Europe et du Monde.* By PAUL BUYSSENS. Brussels, Editions Purnal, 1936. Pp. 270.

The similarities of members of various racial groups has suggested classification based on color. That such a classification is not altogether satisfactory is evidenced by the fact that Hindus, classified as whites, are often as black as negroes. Because of the tremendous complexity of various races and the failure to establish lines of demarcation anthropologists have expressed their discouragement and the problem of racial classification has been neglected.

The author of this book believes that a principle of research is therefore necessary in order to guide further work. He thinks that he has found such a principle in the extreme dissimilarity existing between different ancient arts. The study of these arts reveals the existence of three types of mentality, each distinctly different from the others. More important, each of these three types of mentality belongs to a well known race. This result indicates how the problem of race can be resolved. The differences found correspond to morphological differences as well as psychological ones.

Following his introductory statements, the author proceeds to identify the races. He calls them the Mediterraneans, the Nordics, and the Negroes. Subsequent chapters deal with such topics as the antiquity of these races, their developments as represented by agriculture, navigation, and metallurgy, and their migrations to other continents. Only four pages are formally devoted to a consideration of the psychology of these three races. The author assumes that mind is fundamentally distinguishable into impression and expression. The Nordics are fundamentally of the *expression* type; the Mediterraneans of the *impression* type; and the Negroes have both capacities developed only to an inferior state, neither one of them dominant.

The Training School, Vineland, N.J. ANTHONY J. MITRANO

*Seele als Ausserung.* By PAUL HELWIG. Leipzig and Berlin, B. G. Teubner, 1936. Pp. 124.

The aim of this book is to "describe mind as expression." Expression is defined as the process by which the activities of the inner self are translated or transformed into

external physical structures. The author believes that this point of view makes possible a clarification of the mind-body problem. The "description" of this book is not empirical in character but is represented by a philosophical discussion of various characteristics of "the psychical."

The Training School, Vineland, N.J. GEORGE KREEZER

*This Creature, Man.* By JAMES FRANCIS BARRETT. Milwaukee, Bruce Publishing Co., 1936. Pp. xvi, 364.

Empirical psychology is presented in the first part with far more of the author's general wisdom than of knowledge gathered from the literature of empirical psychology. In the second part there is as good a presentation of the neo-scholastic conception of the soul as has come to the reviewer's attention in a long time. But this second part is not easy reading. Both the editor and the publisher announce the book as a work for the general public, but from it the general public is not likely to learn much about either empirical or rational psychology. There is too little of the former and the presentation of the latter is too abstract and involved.

Indiana University EDMUND S. CONKLIN

*Bibliographies and Summaries in Education.* By W. S. MONROE and LOUIS SHORES. New York, H. W. Wilson Co., 1936. Pp. xvi, 470.

We have here a catalog of more than 4000 annotated bibliographies and summaries of educational topics listed under author and subject-matter in one alphabetical arrangement. The compilers of this list have endeavored to make it complete for the period from January 1, 1910, the date "recognized as the beginning of the modern educational research period," to July 1, 1935, the date when the *Education Index* began to collect similar references for its cumulative lists.

Though the catalog was prepared with care and every effort was made to make it complete, it will be of slight use to psychology as few and only the most general psychological topics are included within its pages.

K. M. D.

*Plain Talk.* By JOHN W. STUDEBAKER. Washington, National Home Library Foundation, 1936. Pp. ix, 166.

The book is a simple account of the problem that confronts the teacher in dealing with freedom, propaganda, and class discussion with special reference to topics in political science and economics. The book is designed for adult education, although it readily could be used as a basis for the thinking of the high school teacher or the college teacher. The chief topics treated are: discussion and education; forums in democracy; liberalism and adult civic education; modernizing adult education; dictatorship by default; and freedom to learn. Each chapter is followed by questions and topics for discussion and suggested references for further reading. The readings are well selected and are on a college level.

The book is not psychological in character either directly or indirectly.

University of Pittsburgh W. T. ROOT

*Nietzsche.* By KARL JASPERS. Berlin, Walter de Gruyter, 1936. Pp. viii, 437.

This work of the well-known psychiatrist and "existential" psychologist may not only be called the most serious ever written about Nietzsche, but it may also

be cited as the most perfect sample of a psychological "Weltanschauungs-Analyse" ever done by the German School in this direction. To introduce the method employed, a short review of the contents might be given: First, survey over life and sickness; second, Nietzsche's fundamental thoughts (man, truth, history and present age, the great politic, world description, frontiers and origin of existence); third, Nietzsche's thinking in respect to his whole personality (how Nietzsche understood himself and how we are understanding him). For psychiatrists it might be important to know that Jaspers again is rejecting the meaning that Nietzsche's sickness has been a demens! He renews his earlier proposition that Nietzsche has had a paralysis for which the definite proof cannot be given.

Baltimore, Md. ERNST HARMS

*Educational Psychology.* By NOEL B. CUFF. Louisville, Standard Printing Co., 1936. Pp. vi, 387.

The content of this text is but another indication that the subject matter of educational psychology almost completely overlaps that of elementary psychology. Dr. Cuff discusses the stock concepts, heredity and environment, maturation, motivation, emotion, maladjustment, intelligence and individual differences, learning, thinking, and socialization in that order. More than a third of the book is devoted to learning. There are discussions of many experiments, and an eclecticism in interpretation which should appeal to middle-of-the-roaders. There is no new viewpoint or radical change in organization presented. It is essentially a content or factual text.

Dr. Cuff has a clear and concise expositional style, which sets his book apart from most contemporary texts. At the end of every one of the fifteen chapters there are discussion and objective questions, selected references which include both books and journal articles. The publishers deserve commendation for their choice of paper and type-face.

On the whole, it appears to be an excellent text for a semester course in educational psychology.

University of Oregon CALVIN S. HALL

*Idealisten en Realisten als psychologische Typen.* By C. A. J. HARTZFELD. Bussum, van Dishoeck, 1935. Pp. 51.

A Dutch law-scholar makes in this pamphlet a not unimportant contribution to social psychology, attempting to classify the general attitude against the social facts of law. Based primarily on the typological meaning of Jung, Phaler, and Kretschmer, he distinguishes two types, an idealistic and a realistic one. He characterizes them as follows. The idealist's interests are for rule and statute; he wishes to clear up the facts and to regulate them. The realist's interests are the facts themselves; he likes simplicity in regard to the circumstances and the ascertaining of them.

Baltimore, Md. ERNST HARMS

*Jugend als Konfliktsituation.* By WALTER BLUMENFELD. Berlin, Philo, 1936. Pp. 122.

The thesis of this book is that the period of youth or puberty may be most readily understood if regarded as a period of transition to maturity, and one

characterized by a variety of conflict situations. In support of this doctrine, the author discusses what he calls the sexual-erotic conflict, the conflict between different generations, the conflicts incident to the choice of a vocation, and the conflicts revolving about the formation of religious and philosophical points of view. In his analysis of these situations, the author explicitly bases his views on Lewin's theories concerning the conflict-situation. The discussion of these topics is preceded by brief summaries of the course of development, particularly during the period of puberty, of salient bodily and behavioral characteristics, by a chapter on "laws of development," and by a review of different theories of puberty. The author's thesis is quite plausibly developed and should be of interest to psychologists and educators. There is a bibliography of about 200 titles, mainly from the German literature.

Vineland, N.J. GEORGE KREEZER

*Experimentell-psychologische Schwachsinnsdiagnostik.* By ERICH STERN. Handbuch der biologischen Arbeitsmethoden, Abt. VI, Teil C[11], Heft 6. Wien, Urban & Schwarzenberg, 1935. Pp. 189.

This book is not, as it might appear by the title, a communication about results of experiments with feeble-minded, but a very good selection of the international testing material useful for denoting feeble-mindedness. Using Claparède's "Conditions for the Value of a Mental Test" as the starting-point, Stern reviews the testing of single functions, of the practical intelligence, of the motor functions, and of the ethical sensations. He further gives an account of the various testing methods for the different ages; the purposive testing, scholastic and professional; the psychological profile; the combined testing methods; and the character tests. Aside from the most important European contributors the Americans, Terman, Gesell, Woodworth, May and Hartshorne, and Tryer, are also reviewed.

Baltimore, Md. ERNST HARMS

*American Foundations: A Study of Their Rôle in the Child Welfare Movement.* By H. C. COFFMAN. New York, Association Press, 1936. Pp. x, 207.

In this sociological survey of the work of the charitable foundations, the author describes the rise of foundations in the United States and their development over the decade 1921 to 1930. He distinguishes between foundations of the general type and community trusts, analyzes and compares the allocation of funds from both types, and then shows the way in which their funds have contributed to child welfare, especially to changes in the conception of child welfare. Of some value to the psychologist are the appendices, especially the list of foundations and the list of child welfare organizations included in the analysis, a table of opinions about foundation policies, and the bibliography.

Brown University J. MCV. HUNT

*Caractere et personnalite.* By E. PEILLAUBE. Paris, Pierre Tequi, 1935. Pp. viii, 224.

This last posthumous work of the teacher in the Catholic University of Paris is, in general, a discussion of the dogmatic Catholic viewpoint (p. 175) and the modern meanings of character and personality, especially those of Bergson and James. In the first part are treated the problems of character: physical basis,

heredity, habits, the basic forces of character (imitation and imagination), and the plasticity of character. The second part deals with personality, in the center of which is placed the problems of liberty and of will.

Baltimore, Md. ERNST HARMS

*Twenty Thousand Transients.* By H. J. P. SCHUBERT. Buffalo, Emergency Relief Bureau, 1935. Pp. x, 150.

In this monograph, Dr. Schubert gives a cross section of the floating population of Buffalo, N.Y., which he obtained during the years 1933-1935 from a study of 20,000 transients. He is concerned principally with landsmen (men and boys), but he considers in separate sections the transient seamen and the transient families and unattached women. He treats of the monthly variation of this population, of their race, age, origin, education, earlier pursuits, mode of travel, length of stay, health, general social background, and length of unemployment and other causes of their wandering. A section explaining the methods used in meeting the emergency closes the study. Dr. Schubert's monograph, though subject to the limitations of the interview-method, will be of interest to students of sociology and of social psychology.

K. M. D.

*Elements of Social Psychology.* By H. GURNEE. New York, Farrar & Rinehart, 1936. Pp. xi, 467.

Gurnee defines social psychology in terms of the interaction of the individual and his social environment. After an introductory chapter in which he presents a clear formulation of the kinds of social interaction, Gurnee devotes a chapter to the methods of social psychology. The remaining chapters deal with learning of social habits, the motivation of social behavior, emotions in social behavior, temperament and personality, perception of personality traits, the development of verbal activity, suggestion, social attitudes, group behavior, social misconduct esthetic activity, and religious activity. The book is well illustrated. Each chapter, in addition to the exercises and projects already mentioned, has a brief list of references.

In the reviewer's opinion this is the best available elementary text in social psychology. The author is to be congratulated on the clear and concise way in which he has been able to bring together and to integrate most of the important facts and principles of social psychology.

Peabody College NORMAN L. MUNN

*Statistical Methods in Biology, Medicine, and Psychology.* By C. B. DAVENPORT and MERLE P. EKAS. Fourth edition. New York, John Wiley and Sons, 1936. Pp. xii, 216.

This small and convenient handbook covers the usual statistical methods employed by psychologists, except for the latest work on factor analysis. It includes also brief sections on measuring instruments, graphing, and labor-saving methods of computation, as well as chapters on special methods in genetics, growth, medicine and other aspects of biology. A valuable set of labor-saving tables is provided for many commonly used functions and equations. Symbols employed are those proposed as standard in the work of Kurtz and Edgerton. The simplicity of style and organization of material commends it for both course work and reference use by experimenters.

University of Southern California ROBERT H. SEASHORE

*Unconventional Ethics.* By OSIAS L. SCHWARZ. Washington, D.C., Perennial Publications, 1936. Pp. 276.

On a street corner one might hear a patent-medicine salesman cite perfectly good evidence from the theory of evolution as a means of leading up to the point that, since men and snakes are biologically related and since snakes are so supple, he could absolutely guarantee that the snake oil he was selling would limber up stiff muscles and joints in human beings.

It is just such a pathetic mixture of some fairly important truths and of sheer buncombe that we have in this book. It contains many really good ideas gathered from liberal social thought, sociology, ethics, and psychology; but Schwarz uses this material with as much contempt for carefulness and truth as does the snake-oil artist.

The following quotation indicates the *typical* style of the book and its high level of psychological sophistication: "While our plutolatrous professors of psychology are allowed to fool around with so-called mental tests, vocational psychology, pseudo character analysis, that is, artificial, pedantic and useless tests of employment-seekers' qualifications, the truly character revealing sciences (graphology, criminal anthropology, ethology, ethical psycho-analysis, physiognomics, phrenology) are left uncultivated and deliberately neglected in our capital- and parasite-controlled colleges; for the cultivation of such sciences, that try to read human character in the human face, in the configuration of the skull, in handwriting, in actions, etc., would deal the death blow to our hypocritical, egotistical and predatory master class and to their nefarious business. Our captains of industry would fly into a rage on hearing their faces described as vulpine, wolfish, piggish, vampire, criminal, or tiger faces" (p. 151).

Cornell College ROBERT LEEPER

*Psychometric Methods.* By J. P. GUILFORD. New York and London. McGraw-Hill Book Co., 1936. Pp. xvi, 566.

The author has written a textbook of statistics applied to psychological problems from the approach of experimental psychology rather than from the more usual approach of mental tests. The book begins with a 200 page treatment of the psychophysical measurement methods which is the first really adequate exposition of this topic in English since the appearance of the second volume of Titchener's *Experimental Psychology* over 30 years ago. And unfortunately, Titchener's work appeared just before the appearance of Urban's major contributions in this field. In separate chapters are treated the methods of average error, of minimal changes, of equal appearing intervals and the constant methods. It is interesting how well this approach lends itself to the explanation of the simpler concepts of statistics, which one had heretofore thought of more usually in terms of test materials.

The next 100 pages are given to a treatment of the psychological scaling methods: paired comparisons, rank order, and rating scale methods. In these chapters, the recent contributions of Thurstone and others are described with exceptional clearness. The last 150 pages contain a discussion of correlation and of test methods. There are chapters on curve fitting; simple, multiple and partial correlation; mental test methods; and a final chapter on factor analysis.

The book is a practical manual for the application of statistical methods to psychological problems. There is a minimum of discussion of the derivation of formulae.

By means of practical problems, the author develops the calculation procedures and the interpretation of the final statistical values. The actual processes of the different calculations are worked out in the text in the form of actual examples. All necessary tables of constants are included either in the text or in an appendix.

During the last few years great advances have been made in the statistical approach both of the psychophysical methods and of test methods. This book represents a real contribution in that it brings together all of these new methods, as well as the old, within a single volume and in that the author explains their applicability and the procedures clearly and simply but still critically.

University of Pennsylvania SAMUEL W. FERNBERGER

*Movements of Thought in the Nineteenth Century.* By GEORGE H. MEAD, with preface and introduction by the Editor M. H. Moore. Chicago, Univ. Chicago Press, 1936. Pp. xxxvii, 519.

This volume which was compiled from the verbatim notes of undergraduate students in philosophy is the second in a special three-volume series of the heretofore unpublished works of the late George H. Mead. These lectures include a wide range of material. The central ideas of such thinkers as Kant, Fichte, Schelling, Hegel, Karl Marx, James, Dewey, Bergson, and others are examined against their respective social and economic backgrounds. Although concerned more directly with philosophical systems, Mead's thought centers around the dialectic of experimental science. Thus science with its insistence upon the right to hypothesize freely, and with its constant modification of old hypotheses in conformity with newly discovered facts, furnishes the pattern for all thought since the Renaissance. It is chiefly by means of this formula that Mead succeeds in demonstrating anew the organic continuity which Kuno Fischer claimed for the history of philosophy.

The author's doctrine of the self is of special interest to both the student of ethics and to the social psychologist. According to Mead, "selves come into being through a process of self-conscious interaction and interpenetration with other selves" (p. xxxi). This ability of the self to assume different rôles promotes the development of the individual self and constitutes the basis of "sympathy," without which a true social order would be impossible. It is hardly necessary, however, to point out that this doctrine of the self which Mead applies ingeniously to Romanticism and other movements is strongly reminiscent of Lipps' doctrine of *einfühlung.*

It is regrettable that much of the writing is marred by faulty English. This defect is especially prominent in the Introduction, and in the rather sketchy chapter on Behaviorism. Nevertheless, the work is an important contribution to the history of philosophy, since it presents many "settled" problems in a new light, and effects a correlation between philosophical thought and social forces. The student who reads this volume will no doubt find in philosophy the interpretation of the actual experiences of men rather than mere mental gymnastics.

Vanderbilt University EUGENE G. BUGG

*Gedächtnisverlust durch Gasvergiftung: Ein Mensch ohne Zeitgedächtnis.* By G. E. STÖRRING. Leipzig, Akademische Verlagsgesellschaft, 1936. Pp. 75.

This monograph is a study of a young locksmith with unusual characteristics of memory following loss of consciousness due to gas poisoning from a furnace. He

has no memory of events following the accident but possesses complete knowledge of his life before that date, such as expressing his wish to marry his fianceé (unaware that they were married following the accident) and that Hindenberg is still President.

The peculiarity of the case is the clear cut loss of only one mental function; namely, the ability to notice things (immediate memory) without disturbing other mental functions, intelligence, emotional behavior, or personality in general. Every perception exists for only 1–1.5 sec. and after that there is no recollection of the impression. He can perform reactions involving constant stimuli, such as dressing and eating, the same as he can accurately recall events previous to the accident upon repeated questioning. Without a constant stimulus, however, he completely fails. Facing the window, for example, he will answer correctly as to the weather (winter); upon being turned from the window he will answer—it is spring (weather at time of accident).

The patient has no other psychic or physical disturbances such as excessive irritability, disturbances of sleep, or habit deviations. The neurological examination was normal. Electroencephelograms and x-rays showed no abnormalities. Associations and intelligence tests were normal, provided there was constant questioning and allowance for momentary answers.

The study is an excellent analysis of a striking impairment of a cortical function, using both psychiatric and psychological testing procedures with precision and insight.

Columbia University ROSS A. MCFARLAND

*The Dream in Primitive Cultures.* By JACKSON STEWARD LINCOLN. (With introduction by C. G. Seligman.) Baltimore, Williams and Wilkins Co., 1935. Pp. xiii, 359.

This work was accepted as a doctor's thesis in anthropology at the University of London and is an attempt, based on library and field work by a well prepared investigator, to apply to the problems of primitive culture Freud's theory of dreams, which he regards as proved by the analysis of neurotic and normal civilized persons. The author has been psychoanalyzed and has attended Jung's seminar, but he rejects Jung's theories. After a short historical review of dream interpretation from antiquity to the present, in which only Freud and Jung appear among the moderns, the author discusses the two types of dreams called "individual" and "culture pattern" dreams, the primitives' theories of dreams (some tribes are Jungian, some Freudian, in their interpretations), culture items (ceremonies, particular totems, works of art, etc.) originating in dreams, the symbols found in dreams (the Freudian symbols for father, mother, birth, the genitalia, death are found to be ubiquitous), and the discovery of the "nuclear complexes" (Oedipus and castration) in dreams and initiation rites of primitives. ("Much of primitive culture seems to arise from Oedipus dreams." Initiation rites "symbolize and dramatize the castration and punishment of the youths for, and the freeing of them from, the 'Oedipus.'") The last section of the book (pp. 189-327) contains a large amount of data; it is a collection of dreams of American Indians from five different culture areas. The documentation of the work appears very complete and shows the scholarly character of the author. The tone of the work is considerably more conservative than one might expect.

Rice Institute FRANK A. PATTIE, JR.

*A Humane Psychology of Education.* By JAIME CASTIELLO. With a preface by Louis J. A. Mercier. New York, Sheed & Ward, 1936. Pp. xxiii, 254.

This book is a mixture of religious dogma, faculty psychology, humanism ('a law for man and a law for animal'), gestalt psychology, Christian ethics and morality, anti-mechanism and anti-connectionism, mind training and sheer mythology. The writer makes little attempt to base his assertions on experimental evidence. His utterances are *ex cathedra.*

The first half of the book is built around the three concepts, reason, creativity, and free-will. These faculties differentiate man from animal. Following this section there is a discussion of a humane curriculum and an espousal of the benefits of the Latin and Greek classics for formal discipline. In the last section the ideal of personality is developed with reference to the personality of Christ.

The book will undoubtedly find favor among those who are not embarrassed by encountering numerous paralogisms and sophistries. It is, however, to be regretted that students of educational psychology, who may have to use this book as a text, will be the victims of autistic and anti-scientific thinking.

University of Oregon CALVIN S. HALL

*Incentives to Composition.* By PHILLIS ROBBINS. Cambridge, Harvard Univ. Press, 1936. Pp. xv, 515.

The central theme of this book written for superior high school pupils is to show them how their experiences of today are related to others' experiences in the more or less remote past. To this end there are short articles from 3–15 pages each in which the facts gathered from near and far in both space and time are related to the living facts of today. These 'setting-up exercises,' well written for the most part, cover a rich variety of factual material such as science, adventure, the outdoor world, decorative art, and fine arts. Under fine arts, for example, appear topics on the open air theater, on the development of the indoor theater, on the story of the column, and on the first great artists. Each assignment reading is followed by questions, exercises, other suggestions for writing usually growing out of the reading material, and a substantial bibliography. The attempt in all these assignments, suggestions, and discussions is to lead the pupil to "recognize that in his own reactions to everyday situations he is only sharing the experiences of other human beings, no matter where they have lived or when."

This text is built on a sound, psychological basis, that of stimulating interest in the strange and remote through showing their relation to the familiar and near. Its weakness lies in the fact that short accounts of important movements sometimes leave us with only a list of abbreviated statements too short to be thoroughly comprehended.

University of North Carolina A. M. JORDAN

*L'Estetica E I Suoi Problemi.* By ETTORE GALLI. Napoli, Casa Editrice Rondinella Alfredo, 1935. Pp. viii, 391.

Although the author regards esthetics as primarily concerned with the metaphysics of the beautiful, he differentiates between his position and that which confines esthetics to a purely rational system unrelated to facts. The facts of the esthetic discipline are, of course, essentially psychic in nature. The discussion of these facts

leads him to divide the body of his work into two parts, the first of which treats general problems of the creative activities and their externalization in art objects. Among the problems here are whether esthetic activity can be psychologically studied, the origin and nature of esthetic sentiments, the nature of esthetic imagination, etc.

The second part is concerned with special problems among which are: the origin and esthetic significance of laughter, the psychology of the spectator of tragic scenes, comparison of esthetic and religious sentiments, etc.

The essentially philosophical character of the work does not preclude the quotation of a number of psychologists, though mostly older writers—for example, Ribot, Sully, Bain, and others. Nevertheless, the temper of Galli's esthetics is not quite in harmony with the esthetic writings of contemporary psychologists.

Indiana University J. R. KANTOR

*Measurement in Psychology.* By THELMA HUNT. New York, Prentice-Hall, 1936. Pp. viii, 471.

The aim of this book is "to familiarize the student with the types of psychological measurement that have been developed." To achieve this, Dr. Hunt describes and discusses the methods that have been used in intelligence examining; in achievement, aptitude, and personality tests; in personnel selection and management in business and industry; and in the physiological methods related to the psychological. The scope of the book is so broad that only the more important aspects of every field are treated. The text is, however, amply supplied with reference for collateral reading so that those wishing to follow a particular topic further may readily do so.

As the topics of the various sections are taken up, they are defined, the methods employed in measuring them are explained, and then the reliability and validity of the methods discussed. Instead of merely naming the test discussed, Dr. Hunt has, to the great convenience of her reader, frequently reproduced the test.

The book is very serviceable for the beginning student in this field.

Cornell University HENRY C. WERNER

*Differential Psychology.* By ANNE ANASTASI. New York, Macmillan Co., 1937. Pp. xvii, 615.

Cattel was largely instrumental in directing American psychology into the field of individual differences. *Velut arbor ita ramus.* His influence has been so great that European psychologists customarily think of American psychologists either as 'rat runners' or 'intelligence testers.'

Despite the pre-occupation of American psychology with the problem of individual differences, the number of compendious works on the subject is small. Previous to this book, only Ellis and Freeman had produced texts on individual differences. This is a surprising fact, since it is much easier to produce a summary of the work on individual differences, where the material is objective and clear-cut, than it is to write a treatise, say, on learning, into which philosophical speculation tends to enter. Perhaps the great wealth of material on individual differences has deterred all but the most industrious from attempting a summary.

Nor should the difficulty of securing mutually exclusive categories for the material of the separate chapters be overlooked. Miss Anastasi has almost succeeded in this task, but she has had to refer to some of the studies several times and in different chapters. Her selection of chapter headings is: Historical Introduction; Nature and

Extent of Individual Differences; Heredity and Environment; General Family Resemblances; Special Family Relationships; the Effects of Training; Mental Growth; the Relationship between Mental and Physical Traits; the Question of Constitutional Types; Variation with the Individual; Mental Organization; the Subnormal; Genius; Sex Differences: Major Problems; Sex Differences: General Results; Racial Comparisons: Problems of Grouping; Racial Comparisons: Problems of Measurement; Racial versus Cultural Differences; Urban and Rural Populations; and the Individual as a Member of Multiple Groups. Such a list shows the width of her reading. Her selection of illustrative studies has a sure touch. In fact, McNemar's study "Sex Differences in Variational Tendency" is the only pertinent study with which I am acquainted that she seems to have overlooked.

The book under review, therefore, is an important one. Not only is the field well covered, but Miss Anastasi, by her critical analysis of the work of others, has laid us all under obligation. She is a keen critic—almost too critical—for we put the book down feeling that after half-a-century of work very little truth has been established. Her skill in statistics has enabled her to punch holes into studies that had previously passed muster. When Baldwin and Stecher's "Growth Curves of Normal and Superior Children in Stanford-Binet Mental Ages" appeared, I pointed out that all they had done was to produce I.Q. curves and misinterpret them, but the curves have appeared in dozens of texts since and accepted without criticism. Miss Anastasi again points out the futility of the study and perhaps, this time, the criticism will be effective.

Although Miss Anastasi valiantly tries to hold the balance true between heredity and environment her general attitude is that of the environmentalist. She may dispute this statement and point to p. 581, but her retraction there only brings out the environmental bias shown in the rest of the book. For instance (p. 217), in refuting Galton's "non-compensation" she suggests a direct behavioral handicap introduced by physical deficiencies. Her theory really supports Galton, although she does not realize it. In general, her greatest weakness is that she does not know her biology and genetics as well as she knows her statistics.

The book, however, is a splendid one and in a fine format. Her treatment of factor analysis is masterly. Throughout the book many shrewd observations are to be found. I think it will be widely used and its success will be well merited. The few errors that have crept in will undoubtedly be removed at the second printing.

University of Toronto PETER SANDIFORD

*Four Million Inquiries from Magazine Advertising.* By HAROLD F. RUDOLPH. New York, Columbia University Press, 1936. Pp. xvi, 101.

This is an extensive and thoughtful survey of the inquiry method of gauging the effectiveness of advertising. Holding constant as many variables as possible, the author presents data on a uniform base to show how size of advertisement, color, headline, size of copy-block, and nature of offer affect coupon-returns. His careful analysis demonstrates a differential effect for each of these factors and indicates as well that each effect varies with the commodity and with the advertisement concerned. The whole section would have gained in value if he had made a direct comparison with a similar study by Starch; as it is, no mention is made of cognate studies by the latter, although at least one of them must have been available at the time of writing.

Rudolph adds materially to the value of his monograph by presenting two sec-

tions which are concerned with other elements that influence the effectiveness of an advertisement. In these sections he deals with the effects of elements in the circulation (position on page, characteristics of medium and coupon-velocity) and with the effects of such extraneous factors as weather and season. These topics, to the best of the reviewer's knowledge, have not received consideration in earlier studies.

The author deserves praise for the fullness of his examination and for his care in avoiding the pitfalls of undue generalizing from specific cases. His early sections suffer from his failure to grasp the distinction between reliability and validity as independent terms. He gives no data on the reliability of the differences shown in his tables, and one wonders whether some of the differences shown and commented on have any statistical significance. The general thoughtfulness and care in exposition, however, outweigh whatever shortcomings the volume may have and mark it as an important contribution to the study of psychology in advertising.

Cornell University JOHN G. JENKINS

*Art and Prudence: A Study in Practical Philosophy.* By MORTIMER J. ADLER. New York and Toronto, Longmans, Green & Co., 1937. Pp. xiv, 686.

This work, in the philosophical tradition of Aristotle, Aquinas, and Maritain, is a scholarly presentation of the moral, political, and esthetic problems of the motion picture. The ancient controversy over the place of the arts in the State is brought up to date in a book which treats of a voluminous and difficult bibliographical background with admirable clarity. The psychologist will be chiefly interested in Adler's critical examination of the experimental literature to see what light is thrown on the practical question of the effect of the cinema on character. Most of the Payne Fund studies are subjected to philosophical annihilation, principally on the charge of lack of scientific caution. Charters' summary volume, and the Blumer-Hauser, Dale, Peters, Dysinger-Ruckmick, and Renshaw-Miller-Marquis reports are treated with particular violence. Adler is less critical of those studies which found results favorable to the movie.

The psychologist will probably be irritated or amused by Adler's classification of psychology as a branch of philosophy, by his repeated references to "empirical research" but never to 'experimental research,' and by his insistence that a science of human behavior is impossible because man's actions are voluntary. Despite his unqualified praise of the Thurstone-Peterson experiments on attitudes, and his milder approval of the Holaday-Stoddard and Shuttleworth-May studies, Adler concludes that psychology has contributed absolutely nothing to his problem.

University of Illinois GILBERT BRIGHOUSE

*Das Wirklichkeitsproblem der Erkenntnistheorie.* By KURT WEINSCHENK. Leipzig, O. R. Reisland. 1936. Pp. xxiv, 184.

Being of a metaphysical nature, the book may not interest many American psychologists. The essence of what the author wants to say may be found in the following (translated) sentences (p. 153): "The doctrine of Descartes was identification of the spiritual, soullike, with consciousness. In comparison, ancient philosophy came closer to the truth. Consciousness is only one spiritual function among others. The will is also one, and indeed the primary."

Coral Gables, Fla. MAX F. MEYER